Who bites back first?: Malaria control in Ghana and the politics of co-existence

Thesis

Who bites back first?

Malaria control in Ghana and the politics of co-existence

Uli Beisel
Diplom in Psychology
Master of Arts in Environment, Culture & Society

The Open University

Thesis submitted for the degree of Doctor of Philosophy in Human Geography on September 1, 2010

Date of Submission: 1 September 2010
Date of Award: 8 April 2011

Für meine Eltern Gertraud und Wolfgang Beisel,

meine Schwester Claudia und die vierte Dame in der Familie, Eika.

and to everyone in Ghana

who ever so generously made me feel welcome, shared knowledge, time and laughter with me.

Medase pa – I still miss the Ghanaian way of life.

The Open University

EX12 (February 2011)

RESEARCH SCHOOL

Library Authorisation Form

Please read and complete this form in conjunction with the EX11 Examination Guidelines for Students. You should return this form to the Research School, The Open University, Walton Hall, Milton Keynes, MK7 6AA with the three bound copies of the thesis and any non-text component, if applicable to be deposited with the University Library. Please note that only theses which comply fully with the binding and presentation criteria as set out in the research degree regulations and the EX11 Examination Guidelines for Students will be accepted for deposition in the University Library. All candidates should complete parts one and two of the form. Part three only applies to PhD candidates.

Part One: Candidates Details

Name: ULRIKE BEISEL PI: Y1254153

Degree: PhD

Thesis title: Who hits back first? Malaria control in Ghana and the politics of co-existence

Part Two: British Library Authorisation [PhD candidates only]

If you want like a copy of your PhD thesis to be available on loan to the British Library Thesis Service as and when it is requested, please tick Section A of this form.

The University has agreed that your participation in the British Library Thesis Service should be voluntary. Please tick either (a) or (b) to indicate your intentions.

(a) ☒ I am willing for The Open University to loan the British Library a copy of my thesis.

(b) ☐ I do not wish The Open University to loan the British Library a copy of my thesis.

Part Three: Open University Library Authorisation [All Candidates]

I confirm that I am willing for my thesis to be made available to readers by The Open University Library, and that it may be photocopied, subject to the discretion of the Librarian.

Signed: ..... Date: 21/4/2011

An electronic version of this form can be downloaded from:
http://www.open.ac.uk/research/research-degrees/directly-registered-students/examinations.php

Abstract

There are many studies about global efforts to prevent, manage and control malaria. What is lacking, however, are studies about the relations between scientific interventions and the broader societal dimensions of malaria. In response to this situation the study brings together insights from human and non-human geographies, science and postcolonial studies as well as entomology.

Malaria is a disease that emerges out of an encounter between three species: *Plasmodium* parasite, *Anopheles* mosquito and human. Accordingly, the object of scholarly attention of this thesis is the encounter itself – the fragile but potentially destructive moment when the lives of three distinct and very much alive species intersect. More concretely, malaria control in Ghana happens in a space where lively mosquitoes meet gold-mining companies, fast evolving parasites encounter enthusiastic vaccine developers and where poor people still struggle to pay for antimalarial drugs.

The theoretical and empirical chapters interrogate malaria as a complex interspecies encounter. I examine the agency of human, parasite and mosquito in constituting and (re)defining the disease. Of particular importance to the analysis are practices that constitute malaria and its control interventions. Ultimately, the thesis advocates new inventive spatial topologies in conceptualizing malaria and practicing its control. I argue that human and non-human practices are profoundly intermingled and together constitute the disease. Malaria is articulated in enmeshed ecologies. Reading malaria in this way documents how humans co-exist with micro-organisms, and problematises the ecological conditions as well as social and political configurations of malaria in a postcolonial world.

Blank Page

Contents

List of Figures

Blank Page

acknowledgments

I **thank** the *Department* of *Geography* at *The Open University* for financial support and intellectual excitement. Particularly my supervisors **Nigel Clark** and **Nick Bingham,** who always provided amazing support, encouragement and pushed me to ask for more of my writing. They were there when I felt like crying and always put up with stubborn detours and intuitions.

All work is collaborative, I have stolen inspiration, ideas and phrases from so many encounters and people, there are more to thank than I can here, but this is:

for all my friends at *The Open University*, *Kwame Nkrumah University of Science and Technology*, *Agogo Hospital* and all those amazing malaria people in Ghana. I thank *Fondation Brocher* in Geneva for providing a beautiful writing refuge in spring 2010.

for inspiration, encouragement and friendship – academic and otherwise I thank: Tillmann Schneider, Ann Kelly, Simon Jan Hutta, Verena Rodatus, Martin Agyemang, Michaela Spencer, Nat Gill, Endre Danyi, Jasber Singh, Aurora Trujillo, Johanna Wadsley and Duygun Erim.

for inspiration, love and for still being my friends – despite PhD neglect and drama: Nele Jensen, Fatos Ustek, Dee Lourens, Steve and Kwame Ameyibor, Anne Schmitz-Hüser, Hilal Akan, Billur Dokur, Angela Last and Elena Vacchelli.

to Carsten Wergin for bringing me on this path in so many important ways. And finally to Edward Akerboom for finding me and for designing this most beautiful cover for me.

Introduction:

Malaria control in Ghana and the politics of co-existence

1.1 The aims of the work: From Ghana to Cambodia and back

Walking along a busy shopping street in Accra I often bumped into Kwaku – an artist and street vendor, who tried to sell me (and many other people) his art work. Kwaku and I frequently engaged in friendly small talk, and once this involved malaria. I asked him about his malaria treatment habits, and he told me that he usually buys artesunate[1] when he feels feverish. He would not go to the hospital, since he says he knows how malaria feels. For him, he says, it is a pain in the belly that comes together with fever. Other people describe different symptoms to me that they specifically associate with malaria. But what everyone seems to agree on is that malaria can be identified easily, you know how it feels in your body after you have had it once. A body that is familiar with malaria does not need clinical or laboratory diagnosis Kwaku would argue, one knows how to self-diagnose malaria. Thus, Kwaku – like most people who have grown up with malaria – is aware of his own malaria symptoms. To him there is no need to spend precious money (and time) in the hospital for a diagnosis, where – as he complains – the doctor or nurse often wouldn't do a blood test for him and would just prescribe malaria medication. And amodiaquine (the nationally recommended first-line drug), no – he does not like it, he says, it makes him too weak. So Kwaku ends up buying artesunate monotherapy in a pharmacy, which is readily available in Accra and he is happy with the effectiveness of the treatment in his body[2].

---

1 Artesunate is an artemisinin-based monotherapy to treat malaria. It is used widely, even though WHO recommended a policy change away from malaria monotherapies and introduced artemisinin-based combination therapies in 2003. This had become necessary because since the 1960s drug-resistance against three important malaria drugs (chloroquine, sulfadoxine-pyrimethamine and amodiaquine) developed and spread on a worldwide scale, necessitating the phasing out of monotherapy. It is hoped that combination therapies will slow down the development of resistance considerably. Despite this widely implemented policy change towards combination therapy, malaria monotherapy and artesunate continue to be widely available, and are popular with patients like Kwaku because they have few side-effects and provide quick relief of malaria's symptoms.

2 More on diagnosis and treatment choices in *Chapter 6*.

Currently this is a good choice for Kwaku, but this might change soon. Malaria control today is at a crossroads. In 2008 world leaders endorsed an ambitious *Global Malaria Action Plan*, involving a 3 billion dollar commitment to reduce the number of malaria deaths to near zero. The new drive towards eradication of malaria began in 2007, when the Bill and Melinda Gates Foundation (BMGF), which quickly rose to paramount importance in global health after its establishment in 1999, announced that they will focus on malaria eradication. After the failure and abandonment of the first eradication campaign in 1969 the WHO advocated malaria management and control over the intervening decades. However, the move of BMGF led to a return to eradication in international policies, resulting in a substantial realigning of funding policies[3]. But soon after the announcement, the revived eradication campaign was met with more sobering evidence that, by all accounts, should have tempered the overwhelming optimism that characterises a policy of malaria eradication. The news came in late 2008 from Pailin, a town in Western Cambodia close to the border with Thailand. Long held fears were confirmed in a letter published by the *New England Journal of Medicine* reporting evidence for artemisinin-resistant malaria in this area (Noedl et al, 2008). In their study Noedl et al found that out of 60 patients treated with artemisinin (the current first-line malaria therapy) four patients had reoccurring malaria, and two of those patients could be characterised as having artemisinin-resistant infection. Drug resistance against the only malaria treatment both highly effective and without major side-effects has started to occur. This is the malaria causing parasite, *Plasmodium falciparum*, in action – redefining malaria: if until December 2008[4] malaria was a disease caused by *Plasmodium* parasites, transmitted by *Anopheles* mosquitoes, and treatable by artemisinin in roughly 48 hours, this has today risen to 84 hours[5] in Pailin (Dondorp et al. 2009: 455). Nevertheless,

---

3 More on the history of the first eradication campaign and the shift back from malaria control to eradication in *Chapter 4*.

4 If we take the publication of the paper by Noedl et al. as a date to indicate the emergence of resistance.

5 The hours measured are so called "overall median parasite clearance times", meaning the time it takes until the parasites are eliminated from the human blood.

for now, malaria is a disease that can still be treated with artemisinin, and in most regions of the world this treatment will be effective in roughly 48 hours.

However, although artemisinin can still defeat the parasites in Pailin, it does so at a much slower pace. And this slower pace can already decide over life or death in a seriously ill patient, 36 hours more for the parasites to live and multiply within the bloodstream can be deadly for a weak body. Moreover, if artemisinin loses its effectiveness the success of malaria treatment is endangered worldwide. This development is all the more threatening, since it has happened before: in the 1960s parasites became resistant to chloroquine. Since its discovery in the late 1930s chloroquine was popular as the first-line malaria treatment all over the world. It was not only highly effective but also a cheap treatment with only minor side-effects. However, after the development of resistance, chloroquine had to be phased out in malarious countries, plummeting malaria control into crisis[6]. And, as the history of resistance against chloroquine teaches us, newly configured parasites –slowly but steadily– broaden their borders. Within a single year artemisinin-resistant parasites have already reached China, Myanmar and Vietnam (Malaria Consortium, 2009). And this was the travel itinerary of chloroquine-tolerant parasites 60 years ago:

---

[6] Even more so because shortly after resistance to chloroquine emerged, treatment with sulfadoxine-pyrimethamine, another common antimalarial drug, started to fail as well. The resistance was detected in the same region around Pailin.

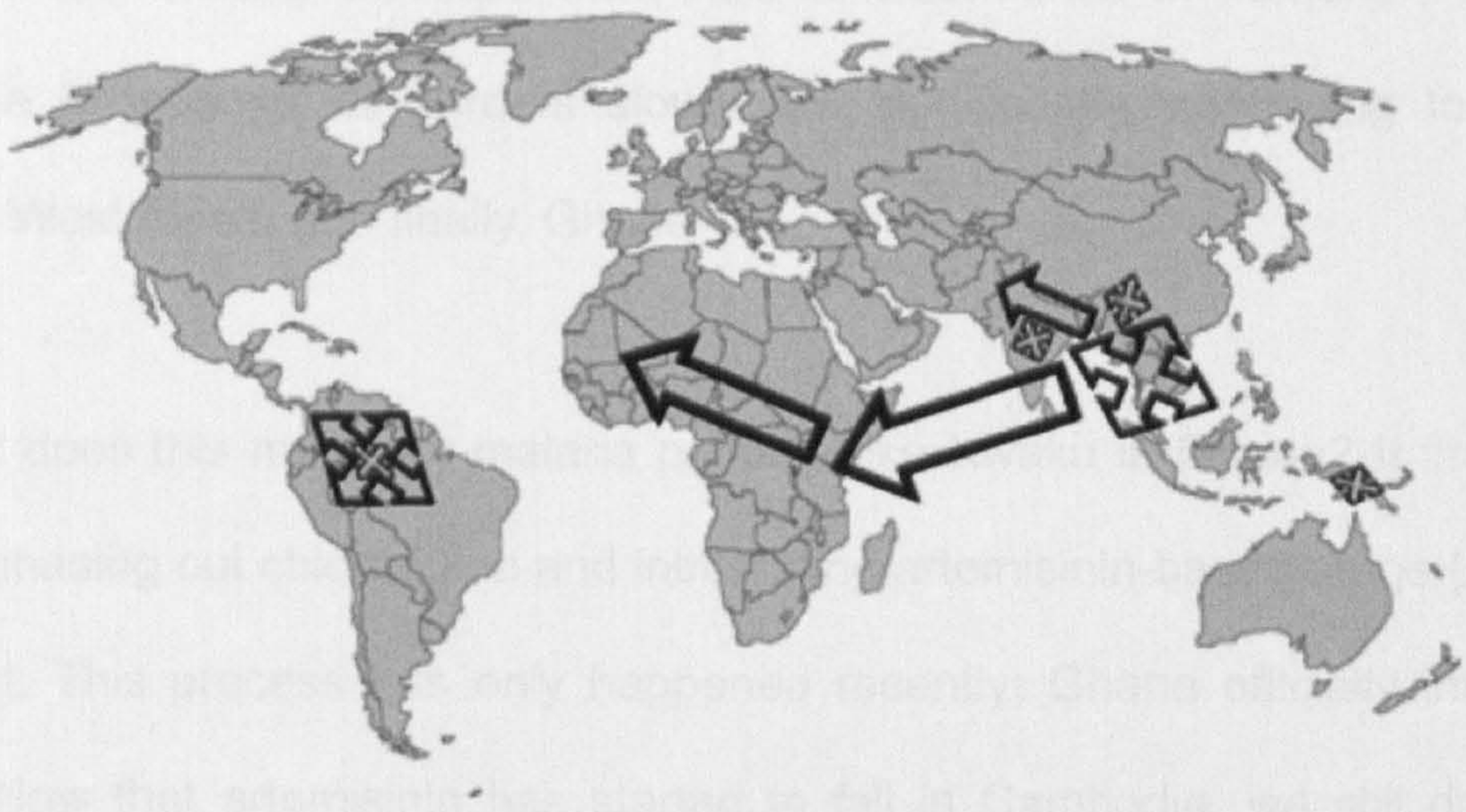


Figure 1: Spread of chloroquine resistance (Plowe, 2008:S12)

Resistance was first reported in the late 1950s along both the Panama-Colombian[7] and Thai-Cambodian borders and radiated slowly and inexorably outward from these two foci, taking 10 years to advance across Thailand to Burma, reaching central India by the late 1970s. Resistance more rapidly disseminated throughout the Amazon region, crossing southwards across Bolivia in the early 1960s and extending to the Atlantic coast of French Guiana and Surinam by the early 1970s. Chloroquine resistance appeared in East Africa in 1978 and moved westward across the continent in a less well-documented pattern owing to limited surveillance in Central and West Africa. (Plowe, 2009: S12)

Rather than a third mutation emerging in Africa, it has been demonstrated that the mutations leading to resistance in Asia and Africa are genetically identical (ibid). Thus, the resistant parasites must have *travelled* from Asia to Africa. This is believed to have happened not

[7] This second epicentre is not focus of my discussion here, mainly because it remained contained to the South American continent and hence had little direct influence on malaria in Africa.

through mosquitoes that hitched a ride on a plane or boat[8], but rather chloroquine resistance presumably travelled from Asia to East Africa in *humans*[9]. From East Africa resistance broadened its borders slowly but significantly, continuing to travel overland, reaching West Africa, and finally, Ghana[10].

So, what does this mean for malaria patients like Kwaku in Ghana? It first meant a policy change phasing out chloroquine and introducing artemisinin-based drugs (ACTs) as first-line treatment. This process has only happened recently; Ghana officially introduced ACTs in 2005[11]. Now that artemisinin has started to fail in Cambodia, we still do not know when these treatment failures will reach Ghana, but the odds are they will eventually. And then, this will affect malaria patients such as Kwaku yet again. When Ghana changed the policy from chloroquine to artemisinin the biggest challenge was the price: .artemisinin-based therapies are roughly ten times more expensive than chloroquine. This makes the new treatment unaffordable for most patients in sub-Saharan Africa[12] – a tendency likely to increase with the need for another malaria drug to be developed (that as of now does not exist). Emerging resistance defines eradication attempts as an arms race: while philanthropists and policy makers aim to shrink the malaria map, the parasite adapts to the drugs and obeys to its own cartographic logic.

The aim of this thesis is to scrutinize this arms race in detail: in its historical context, its current policy constellation, and most importantly through malaria control practices in Ghana

---

8 In the 1930s anopheles gambiae travelled on warships carrying post from West Africa to Brazil, triggering falciparum malaria epidemics around the port of Natal (Killeen et al. 2002:620). In Egypt it is assumed anopheles gambiae came into the country during WWII either on British airplanes or via boat traffic from Sudan (Mitchell 2002: 22).

9 According to Campbell et al. (1979) it is likely the parasite hitched a ride with South-East Asian workers, who came to East Africa in the 1970s to built a railway from Beira in Mozambique to Kinshasa in DR Congo (then Zaire). Malaria resistance travelled in *people*, the workers unknowingly helping to spread the resistant parasite in Africa.

10 Here, it is important to keep in mind that the concept of resistance does not mean drugs fail in 100% of cases. It means that the efficacy of a drug is reduced, but as we will see in section three, for some people the drug might still work well. Resistance is a gradual, not absolute phenomenon.

11 More on this in *Chapter 4*.

12 More on this in *Chapter 4*.

today. From these explorations I hope to gain insights into imaginaries and practices of malaria control today, and into its spatial and political configurations. Here, I am particularly interested in exploring the heterogeneous, contingent and sometimes contradictory practices which are performative and constitutive of the politics in question. The development, spread and consequences of malaria drug resistance has usually been answered by acceleration: resistance is to be overtaken by developing deadlier substances fast, and decisively replacing expired ones, ultimately aimed at sustainable pipelines of drugs. However, the threat of drug and insecticide resistance casts temporalities and spatialities of progress into sharp relief, raising questions about whether a strategy of 'quicker, faster, stronger' provides us with the most robust link between the lab-scapes of innovation and the landscapes of wellbeing that affect patients such as Kwaku.

This poses a question about agency. Resistance pushes us to ask if humans are really as much in control as policy narratives suggest we are. Emerging resistance and its spread shows that life is not easily separable in human and other-than-human processes; in the development of malaria *Plasmodium* parasites sneak into our body, penetrate our red blood cells, and make us ill. Blood-seeking *Anopheles* mosquitoes are the vehicle that parasites not only use to travel from human to human, but in whose midguts they also fulfil one part of their reproductive cycle, the other half of multiplying happening in the human blood. Resistant parasites redefine what malaria treatment means and they force humans to rethink control measures. Human and nonhuman organisms, social and biological process are inescapably intertwined in the emergence of malaria. The human/nonhuman distinction is done actively through certain practices and gets blurred through other practices and experiences – be that human or other-than-human practices. This thesis is, thus, first and foremost an inquiry into agency. It asks where and by whom malaria gets defined and which practices constitute the disease, and it aims to think through how a malaria policy can be

composed that grants agency both to people and nonhumans.

Though special attention will be paid to migratory *Plasmodium* parasites and mutating *Anopheles* mosquitoes, it is important that writing about malaria in Ghana also involves thinking through human-human encounters and power dynamics. Malaria as a disease was integral to the success or failure of imperial missions, and helped define geographic spaces of colonialism. In West Africa for instance, durable settlements were long confined to the coastal zone – an obstacle for some and a blessing for others. As Nigerian S.D. Onabarimo has put it succinctly, "Let us give thanks therefore to that little insect, the mosquito, which has saved the land of our fathers for us" (cited in Russell, 1955: 244). Research on malaria has contributed substantially to the establishment of the discipline of Tropical Medicine and to the history of Western biomedicine more broadly. Colonialism and medical research have thus been profoundly intertwined, and legacies of this history are still found in today's malaria control. For instance, as we will see in *Chapter 4* most of today's funding for malaria control comes from Western development donors and philanthropic organisations. While the configurations of those funding policies and power relations are far more complex and cannot be linked to imperialism in a straight-forward way, they still point to residues of colonial practices and policies. Similarly, *Chapter 7* will discuss how economic constellations in bednet production and implementation privilege international business from developed countries and marginalise local small-scale development. In this sense colonial legacies come into play in concrete malaria control interventions. They have a bearing on how the disease is conceptualised, and how its control is financed and logistically organised. As Donna Haraway points out, effects of imperialism can also be traced through pervasive tropes defining what it means to be ill or healthy:

> Expansionist Western medical discourse in colonizing contexts has been obsessed with the notion of contagion and hostile penetration of the healthy body, as well as terrorism and mutiny from within. This approach to disease involved a stunning reversal: the colonized was perceived as the invader. In the face of disease genocides accompanying European "penetration" of the globe, the "coloured" body of the colonized was constructed as the dark source of infection, pollution, disorder, and so on, that threatened to overwhelm white manhood (cities, civilization, the family, the white personal body) with its decadent emanations. In establishing the game parks of Africa, European law turned indigenous human inhabitants of the "nature reserves" into poachers–invaders in their own terrain–or into part of the wildlife. The residue of the history of colonial tropical medicine and natural history in late twentieth-century immune discourse should not be underestimated. Discourse on parasitic diseases and AIDS provide a surfeit of examples. (Haraway, 1993: 393)

(Post)colonial politics has, thus, manifested itself in funding structures, is inscribed in tools of malaria prevention and treatment, as well as contributing to the understanding and definition of public health and disease control in Africa. In this sense, my analysis of malaria and its control in Ghana involves not only thinking through the relationship between parasites, mosquitoes and humans, but, importantly, has to incorporate human-human encounters. Here, I ask how and by whom malaria control interventions get designed, who and what gets left out and what effects these omissions might have.

Ultimately, the thesis aims to think through how local malaria control policies could be improved in order to provide the best possible care for Ghanaians like Kwaku, while – at the

same time – keeping the global malaria situation in mind and in balance. We will explore these questions in more depth in the following chapters. The following sections of this introduction will reflect on my first arrival in Ghana in autumn 2007 (*Section 1.3*), provide a brief overview over Ghana and its public health system (*Section 1.4*), before introducing my research methods and sites (*Section 1.5*). Finally I will provide a brief overview over the chapters to come (*Section 1.6*). But before we can concern ourselves more with the specificities and practices of malaria control worldwide and in Ghana, there is a need to provide an introduction to what *malaria* actually is. This will be the subject of the following *Section 1.2*.

1.2 Malaria

> *Everything about malaria is so moulded and altered by local conditions that it becomes a thousand different diseases and epidemiological puzzles. Like chess, it is played with a few pieces, but is capable of an infinite variety of situations (Louis W. Hackett, 1937: 28)*

In the spirit of this quote from the famous malariologist Louis Hackett, this section will not provide an overview, or explain in detail what malaria is, but rather describe the few centrepieces of this complex puzzle[13]. There are three of them: Malaria is the result of an encounter between *Plasmodium* parasites, *Anopheles* mosquitoes and a human host. There are five species of *Plasmodium* known to cause malaria in humans: *Plasmodium falciparum,*

---

[13] In the following I describe the scientific explanation of malaria condensed into a very brief section and use as little technical terminology as possible. While the section aims to avoid scientific oversimplification, I also aim for an easily understandable introduction. The information is mainly based on Warren and Gilles' "Essential Malariology" (2002), as well as the video animation of the malaria life cycle offered by the Malaria Journal: http://www.malariajournal.com/graphics/videos/plasmodium_cycle.asp. For an accessible yet scientifically grounded introduction to the malaria see also the Wikipedia entry: http://en.wikipedia.org/wiki/Malaria

Plasmodium vivax, *Plasmodium ovale, Plasmodium malariae* and *Plasmodium knowlesi. P. falciparum* is most important, because it not only causes the most virulent form of malaria but also accounts for 92% of malaria cases worldwide and for 98% in Africa (WHO, 2008b). In short, malaria is the result of *Plasmodium* parasites entering the human blood stream, where they – through reproduction in the human red blood cells – cause the disease symptoms in humans that have become known as malaria. I will discuss the life cycle of malaria in more detail below, but before this we need to introduce the second centrepiece of the malaria puzzle.

This is its vector, the *Anopheles* mosquito. Currently, worldwide 430 species of *Anopheles* mosquitoes have been identified, of which around 70 are malaria vectors. But there are likely to be more, as counting species in malaria transmission is a complex task. It was first recognised in the 1920s in Italy that what had until then been referred to as a single species turned out in many cases to have been a complex of species that are morphologically identical, but display differences in genome and behavioural traits (Hackett, 1937). So, one so-called *complex* of mosquito species consists of different sub-species that are reproductively not connected to each other. This is true for both *A. gambiae* and *A. funestus,* which are recognised as the two most prevalent malaria vectors in Africa. So this rich diversity of *Anopheles* mosquitoes transporting the parasite from and to humans is the second piece of our puzzle.

The third centrepiece of malaria is humans, the host to both *Plasmodium* parasites and *Anopheles* mosquitoes. And this is a short version of their encounter with the human body: The life cycle of malaria is propelled by the female mosquito's need of blood to nurture her eggs. Anthrophilic mosquitoes bite every two to three days. They are attracted by and can

find their way to humans via our body heat, odour and carbon dioxide emissions. But as well as the nurturing blood that is sucked into the mosquito when it bites humans, *Plasmodium* parasites travel into the mosquitoes' midgut during the blood meal.

In the mosquitoes' midgut the sexual stage of the parasites' reproduction and genetical recombination takes place. The pace of reproduction depends highly on the temperature in the midgut: If it is warm and cosy with 28 degrees the maturing of new parasites takes 9-10 days; with only 20 degrees the parasites needs 3 weeks to reproduce; and if the mosquitoes' temperature is below 18 degrees the reproduction cycle usually exceeds the life span of the mosquito[14]. After the reproduction around 10,000 newly emerged parasites leave the mosquitoes' midgut and swim to the thorax. However, less than 25% reach the salivary gland. The few successful ones then complete maturing in the salivary glands. This second maturing phase is important because when they first reach the salivary gland, the parasites' capacity to infect humans is quite low, but significantly increases after maturing for a few days – the parasites' adolescence if you like. Once this is completed the *Anopheles* is infective, and may remain infective for the rest of her life. So, between 10 and 25 days after the initial parasites entered the mosquito, the reproduced parasites are ready to travel again.

Whenever the mosquito needs new blood and bites, it first releases a drop of saliva into human blood. But even though thousands of parasites will have accumulated in the mosquitoes' saliva, only 25 or less are normally released per drop, with only 10% of *Anopheles* injecting more than 100 parasites into the human host per bite. Furthermore, once in the blood stream, and within only minutes, many parasites will be destroyed by

---

[14] Here and in the following I describe *Plasmodium falciparum* malaria, since it is the prevalent one. Other species of *Plasmodium* have significantly different life cycles and symptoms that cannot be discussed here.

macrophages and the immune system defences more broadly. The few that escape take from minutes to an hour to reach and settle in the human liver. Here the second phase of reproduction of the parasites begins. This time the process is not sexual, but the parasites reproduce via meiosis (schizogony). This usually takes five days, and then roughly 30,000 parasites are released into the blood stream from the liver. The parasites escape from the liver undetected by wrapping themselves in the cell membrane of the infected host liver cell. A few seconds after they get released, the parasites attach to red blood cells, penetrate into them and form separate compartments in the cell, where they further develop. This is an energy consuming process for the cells: an infected cell consumes approximately 100 times more glucose than non-infected cells. The parasites at this stage also release protein in the cell, some of the exported protein transforms the cell membrane and produces knobs, which make infected cells cling together in blood vessels, clogging up the vessels and hindering the blood flow.

This stage lasts for approximately 48 hours, and then the cells burst. The released new parasites attach again to blood cells, and the multiplication cycle starts anew. When large numbers of cells burst at the same time the symptom-complex called malaria is triggered. The onset of malaria is roughly 12-14 days after initial infection, and the classic symptoms are cyclical occurrence of sudden coldness, rigor, and then fever and sweating. The cycles of fever depend on the *Plasmodium* species; *P. falciparum* can have recurrent fever spikes every 36–48 hours, or a less pronounced and almost continuous fever. The most severe version of malaria is cerebral malaria, where high fever is accompanied by convulsions, semi-consciousness, unconsciousness, or reversible coma. Cerebral malaria can be fatal within days of the first malaria symptoms if left untreated.

But back to the parasites. When released into the blood stream through busting the red blood cells, some parasites invade cells again in order to continue the reproduction process. Some parasites, however, develop into female and male stages. Those parasites remain in the blood stream and can be digested by mosquitoes again, and so the cycle of malaria continues. We can see that the life cycle of malaria is complex and takes weeks to be completed. Importantly, the parasites spend between 10-25 days in the mosquito before even entering the human body. Bio-statistically this should make malaria a highly unlikely disease. On average mosquitoes live between 10-15 days, and "these facts together lead to one of the great ironies of malaria: most mosquitoes do not live long enough to transmit the disease. These facts also mean that the majority of eggs a female will produce in her lifetime are laid in the window before malaria-infected mosquitoes can become dangerous to humans" (Read et al., 2009:2).

Nevertheless, the WHO records that malaria occurs in 109 countries, "about half the world's population (3.3 billion) live in areas that have some risk of malaria transmission and one fifth (1.2 billion) live in areas with a high risk of malaria (more than 1 reported case per 1000 population per year). Another 2.1 billion live in areas of low risk" (WHO, 2008b: 9). "There were an estimated 247 million malaria cases (5th–95th centiles, 189–327 million) worldwide in 2006, of which 91% or 230 million (175–300 million) were due to *P. falciparum*. The vast majority of cases (86%) were in the African Region" (ibid: 10). Furthermore, "there were an estimated 881 000 (610 000–1 212 000) deaths worldwide in 2006, of which 90% were in the African Region, and 4% in each of the South-East Asia and Eastern Mediterranean Regions. An estimated 85% of deaths occur in children under 5 years, but the proportion is much higher in the African Region (88%). Eighteen countries accounted for 90% of deaths in the African Region", out of which Ghana is one (WHO, 2008b: 12).

It has to be noted at this stage that those numbers can only provide a very rough impression of the malaria situation: a discussion of measurement problems as well as of the performative aspects of these statistics can be found in *Chapter 4* of the thesis. For now, this shall suffice as a basic version of the malaria puzzle, as subsequent chapters will explore many specificities of malaria in more detail. And while I take it as self-evident that malaria is an outcome of a deadly blood meal taken from man by the mosquito, ,as we will see as the thesis unfolds, the historical, sociological and political life of the pathogen exceeds the moment of this parasitological exchange. But before this is explored more thoroughly, the following sections will introduce the specificities of the empirical research that has been done for this thesis. In the next section (*Section 1.3*) I will recount some memories of my arrival in Ghana in autumn 2007, before providing a short introduction to Ghana, its health care system and malaria situation (*Section 1.4*). *Section 1.5* will then detail the fieldwork methods, sites and the material generated through the research, while *Section 1.6* provides a brief overview of the main chapters of the thesis.

1.3 Arrival in Ghana

More than anything, one is struck by the light. Light everywhere. Brightness everywhere. Everywhere, the sun. Just yesterday, an autumnal London was drenched in rain. The airplane drenched in rain. A cold wind, darkness. But here, from the morning's earliest moments, the airport is ablaze with sunlight, all of us in sunlight. [...] Something else strikes the new arrival even as he descends the airplane: the smell of the tropics. It is the smell of a sweating body and drying fish, of spoiling meat and roasting cassava, of fresh flowers and putrid algae – in short of everything that is at once pleasant and irritating, that attracts and repels, seduces and disgusts. This odour will reach us from nearby palm groves, will escape from the hot soil, will waft above stagnant city sewers. It will not leave us;

it is integral to the tropics. (Ryszard Kapuscinski, The Shadow of the Sun, 2001: 3-5)

These are Ryszard Kapuscinski's[15] first impressions on arrival in Ghana, 1958 – one year after Ghana became the first country in Africa to attain independence. Kapuscinski's writing is famous and contested, I like some of it, and some I don't. However, his observations on arrival in 1958 resonate with the feelings many travellers might have landing in Accra. Here are some of the first notes in my field diary, written in Accra in September 2007:

Only seven hours in a comfortable extension of Britain, the British Airways plane, connect Accra with London, Africa with Europe, a malaria high-risk zone with one of the hotspots of finance and power flows. I imagine that maybe the minute I leave the plane and are set back by the loss of my breath –through the humidity, heat and dust of the tropical air– at the same moment back in London, in a pompous and power-soaked atmosphere in a historical chamber in the British House of Commons, members of parliament, malaria scientists and international policy makers might discuss problems and chances of a new international subsidy system for malaria drugs. Meanwhile in a hospital in Kumasi my sister, a medical student from Germany, witnesses the malaria-death of a small child; a daily reality there, for which at this particular day the nurses can't spare enough of their time to relieve the other two ill children, who share a bed with the dead child, from the presence of death next to them for hours.

Arriving in a tropical and malarious country not for the first time, I find myself caught once again in colonial binaries of the lush tropics and its dangers; between the perception that

---

[15] For the controversy see : "At play in the bush of ghosts", by anthropologist John Ryle in 2001, available via: tp://www.richardwebster.net/johnryle.html (20/06/2010).

malaria is the 'African cold' and the fear that the parasite kills fast and has no mercy with non-immune babies and tourists; between the normality that malaria has here and the Unbehagen (discomfort) that I can feel when Yaw, a local geography student and friend of mine, tells me about his last malaria attack, which happened four years ago and he still remembers as "really bad". I can hear the pain in his words, a pain that is written into his body-memory. His advice to take preventative medicines when I travel into a high-risk area inevitably sticks as a shadowy reminder of the threat of the bountiful tropics, the trauma. This unease does not sit well with my idealistic and intellectual understanding of malaria, where malaria is a part of life that the Western tourist/student, I, should not avoid through a practice of privilege. A moral imperative joined up with an understanding of health, where the encounter with illness is part of a healthy life, where the experience of health's other gives rise and shape to the desirable state of being.

After adjusting to Ghana by spending some time with my sister in Kumasi and travelling around with her for two weeks, I spent most of my first two months in Accra conducting interviews with policymakers from the National Malaria Control Programme (NMCP), WHO, UNICEF, with researchers from the University of Ghana as well as with representatives of various NGOs and development agencies concerned with malaria control. In this process one inevitably has to familiarize oneself with the geography and social life of Accra – a process that is not always easy and can be frustrating. For instance, it took me two days to find the offices of the NMCP:

Ghana's National Malaria Control Programme (NMCP) is non-existent on the internet, which even surprised students at the Geography department, who I asked for help to find their address or phone number. From a well-known Ghanaian malaria scientist I get the only partially helpful advice of "they are near the Novotel, have their own building". After several

phone conversations with the Ghana Health Research Unit ["Sorry, Madam, I don't have it, please"], the Ghana Health Service [after two minutes silence as a first response to my question the person on the phone says "call this number", the number does not work, I call back, "oh, just try again, sometimes the network does not work", aha thanks], I finally get a helpful answer from the Ministry of Health: the person on the phone gives me the number of someone, who then gives me two numbers, I ask if this now is the number of the NMCP, he says "yes", but does not seem convinced himself. I try the number, it seems to be the NMCP, the person on the other end gives me the postal address (which is at Korle Bu hospital, not close to Novotel). I ask him for a visitor address, and get the helpful answer, close to Novotel… OK, thanks to the malaria scientist I already knew that. I am tempted to hang up and just go to Novotel and ask people around there, but then remember a Ghanaian friend laughing at me when I had –earlier in the search process– suggested this option, he said "no, Ghanaians don't even know where they themselves live, you have to press them for proper directions". Keeping this in mind I ask the person on the phone for more information, he says "we are on the premises of the Food and Drug Board". OK, I think, this should be enough to find their premises with the help of a taxi driver. The next day, I take a cab to the premises of the 'Food and Drug Board near Novotel'. The taxi driver of course ignores the second part of my sentence and brings me to the Food and Drug Board premises, which are not really close to Novotel. Of course, it's the wrong location, it turns out the Food and Drug Board has premises closer to Novotel as well. OK, another cab (it's too hot to walk at 11am) to Novotel. At Novotel, I explore the area around it a little and soon spot some ugly, run-down buildings that look like governmental buildings. I walk towards them and see a small road into a yard with two signs, one is old and says 'Lab Food and Drugs Board' and one is new and shiny and says 'National Malaria Control Program', 'Global Fund' and 'Roll Back Malaria'. The buildings are likewise. The Food and

Drug Board labs looks run down[16]*, while the NMCP building at the end of the yard is new and painted nicely. Is the building built from Global Fund money? The answer is 'yes' as a memorial sign on the building kindly informs me. Finally, here I am – the National Malaria Control Programme. Amazing, how finding an address can take nearly two days of work.*

Figure 2: The premises of the Ghana National Malaria Control Programme

Things work differently in different parts of the world, and after two months I had learned how to navigate through Accra, graduated from using taxis to the public bus system (trotros), knew how to ask better questions and accustomed myself to a tropical rhythm[17]. Overall, getting to know Accra was fun and I grew to love the city; in terms of conveying at least some of Accra's flair –albeit written about Accra in 1953– Ryszard Kapuscinski again succeeds for me:

I've been here for a week. I am trying to get to know Accra. It is like an overgrown small town that has reproduced itself many times over, crawled out of the bush,

16 Ghana is changing quickly, by March 2008 the Food and Drug Board had moved into new, shiny buildings, apparently built with support from US AID.

17 This really is a bodily process, throughout my time in Ghana I for instance practiced walking slowly by walking behind a person and not allowing myself to overtake. Walking too quickly makes one sweat too much, which tires one out too quickly – an experience I often suffered from in the first weeks.

out of the jungle, and come to a halt at the shores of the Gulf of Guinea. Accra is flat, single-storied, humble, though there are some buildings with two or more floors. No sophisticated architecture, no excess or pomp. Ordinary plaster, pastel-colored walls – pale yellow, pale green. The walls have numerous water stains. Fresh ones. After the rainy season, entire constellations of stains appear, collages, mosaics, fantastical maps, flowery flourishes. The downtown is densely built-up. Traffic, crowds, bustle – life takes place out in the street. The street is a roadway delineated on both sides by an open sewer. There are no sidewalks. Cars mingle with the crowds. Everything moves in concert – pedestrians, automobiles, bicycles, carts, cows, and goats. On the sides, beyond the sewer, along the entire length of the street, domestic scenes unfold. Women are pounding manioc, baking taro bulbs over the coals, cooking dishes of one sort or another, hawking chewing gum, crackers, and aspirin, washing and drying laundry. Right out in the open, as if a decree had been issued commanding everyone to leave his home at 8 a.m. and remain in the street. In reality, there is another reason: apartments are small, cramped, stuffy. There is no ventilation, the atmosphere inside is heavy, the smells stale, there is no air to breathe. Besides, spending the day in the street enables one to participate in social life. The women talk nonstop, yell, gesticulate, laugh. Standing over a pot or a washbasin, they have an excellent vantage point. They can see their neighbours, passersby, the entire street; they can listen in on quarrels and gossip, observe accidents. All day long they are among others, in motion, and in the fresh air.

(Ryszard Kapuscinski, The Shadow of the Sun, 2001: 5-6)

This section is not aimed at analysing my arrival, positionality, or attempts to draw a picture of Ghana, I rather tried to provide an entry point for my readers – a first window into my

research and Ghana. It aimed to evoke and entice, to enrol the readers into the geographical and intellectual journey this thesis ventures on. But before I describe my research methods and sites in more detail, some more information about Ghana, its public health care system and malaria in the country will be provided in the following section.

1.3 Ghana: public health and malaria control

Figure 3: United Nations Cartographic Section, Country Profile Map Ghana, 2006

Geographically in the heart of Western Africa and with a coastline on the Gulf of Guinea, Ghana is often considered an exception in the region. Most significant from a historical perspective is that Ghana was the first country in Africa to become independent from its colonial control. On March the 6th in 1957, after years of protests, riots the liberation struggle was successful. Independence was fostered through the rise of a Pan-African movement amongst Ghanaian intellectuals of the time, the movement was headed by Osagyefo Kwame Nkrumah, who was educated (inter alia) at the London School of Economics. In 1957 the British colonial powers surrendered, and returned the Gold Coast to its people. The newly formed country was named *Ghana*, the name derived from the *Ghana Empire*, an ancient West African kingdom (which existed c.790-1076). The name was suggested by another important independence fighter Joseph Danquah, because –according to his research– the people of Ghana were connected to the ancient Empire. This is, however, disputed, since the Empire was located in today's southeastern Mauritania and western Mali, the modern territory of Ghana never formed part of the previous polity. The word *Ghana* means *Warrior King* and was the title accorded to the kings of the Empire. In 1960 the *Republic of Ghana* was adopted as the legal name for the territory formerly called the *Gold Coast* and *British Togoland*. Osagyefo Kwame Nkrumah served as Prime Minister and later President of Ghana from 1957 until 1966, when he was overthrown by a military coup while abroad, and was forced into exile in Conakry, Guinea until his death in 1972. Nkrumah was politically well known for his strong commitment to Pan-Africanism, and he had significant influence in the founding of the *Organization of African Unity* (today *African Union*). Osagyefo, meaning "the redeemer" in Twi, remains an inspirational figure for many; he is buried in the heart of Accra, at the *Kwame Nkrumah Memorial*, close to the country's *Independence Arch*.

Figure 4: Accra Independence Arch

From Nkrumah's overthrow until the accession to power of Jerry John Rawlings in 1981, Ghana was politically unstable and experienced a series of military coups. Rawlings, who has a Ghanaian mother and a Scottish father, was Ghanaian President for 19 years, the first 11 years under one-party rule and with suspended constitution. Nevertheless, in the 1980s Rawlings agreed to open the country to influence from abroad, and implemented the World Bank's structural adjustment programmes. Subsequently, in 1992 he opened the country again for multi-party elections and reinstated a constitution. Rawlings and his National Democratic Congress (NDC) won the majority of votes in the 1992 democratic elections and he served as the country's President until 2000 (when he had to step down, because the constitution allowed only two terms). From 2000, the opposition party National Patriotic Party (NPP) was in power for two consecutive terms, under the leadership of the Oxford University educated John Kufuor, who served as the country's President until 2009. As John Kufuor too had reached his two term limit in 2009, he stepped down at the 2009 elections. In a closely fought election the NDC won power again, and the London School of Economics educated lawyer John Ata Mills became President of Ghana. Ghana can thus look back to two peaceful changes of power with free and fair elections in the last decades. In the eyes of many this makes the country a prime example for African democracy, and forms a stark

contrast to the surrounding region that has been marked by civil wars (e.g. Sierra Leone, Liberia, Cote d'Ivoire), continuing (semi)dictatorships (Togo) and political instabilities (perhaps most pronounced, recently, in Guinea and Nigeria).

Well endowed with natural resources – particularly gold and cocoa, as well as the more recently discovered offshore oil depots – Ghana has roughly twice the per capita output of the poorer countries in the region. Nevertheless, the country remains dependent on trade with multinational companies – who are up to today exploiting most of the gold and cocoa resources, on international assistance in form of development aid, as well as on remittances and investment activities of the Ghanaian diaspora. About 28% of the population live below the international poverty line of US$1.25 a day, the vast majority of whom are women from the politically marginalised and poor Northern, Upper East and Upper West Regions (UNDP, 2008). According to the World Bank, and despite their imposed structural adjustment programmes (SAPs) in the 1980s, Ghana's per capita income has barely doubled over the past 45 years, although the World Bank reports that growth has remained stable from 1988 onwards, with the GDP rising from US$ 5.2 billion (1988) to 16.7 billion (2008) (World Bank, 2009). However, while it is widely accepted that the structural adjustments programmes improved the economy on the macro-level, the withdrawal of the state, particularly in the education and health sectors, had devastating effects on the micro-level, as Ghanaian economist Kwadwo Kondau-Agyemang argued:

The implementation of SAPs has not only culminated in the retrenchment of over 300,000 public sector workers, but has also led to unprecedented cuts in state expenditures on public services and social welfare and the introduction of user fees for health and education. Thus access of the poor to health and educational

services has been reduced. (...) The people in the rural areas as well as the poorest of the poor in the urban areas seem to have suffered significantly due to their inability to compete in the market. While Ghana's economy may perhaps be experiencing the best of times at the macro level (compared to the 1970s), the benefits have not trickled down to all parts of the country, and to all socioeconomic groups. Living conditions have become harsh for the poor, especially the residents of the rural areas and savanna belt, whose access to education, health, and other services has been severely curtailed under Structural Adjustment Programs. (Konadu-Agyemang, 2000: 474-481)

Thus, SAPs produced an uneven geography of economic growth. For instance many health sector facilities are grossly understaffed and show significant spatial unevenness: while Accra has one government-employed physician per 5,300 people, the ratio rises to 1:64,000 in the Northern Regions of Ghana (ibid: 744). This trend is further deepened by "brain drain" migration of highly skilled medical personnel to developed countries, notably to the UK National Health Service. Macintosh et al. report that "over 50 per cent of doctors trained in Ghana have migrated, and majorities of current medical and nurse trainees plan to migrate (Buchan and Dovlo, 2004; Gent and Skeldon, 2006). Cuban doctors work in some of the most deprived districts, but this is not a permanent solution" (Macintosh et al., 2006: 761). The *Ghana Core Welfare Indicators Questionnaire Survey* (2003) states that only 57.6% of the population live within 30 minutes of a health facility, which goes down to 27% for the rural poor, where distance from a health facility can rise to hours or even days of travel (with the poorest often having to cover the journey by foot).

Nevertheless, in indicator rankings Ghana is generally does fairly well in the African comparison, the *Human Development Index* for instance records a literacy rate of 65% and

an average life expectancy of 65.5 years (UNDP, 2009). The overall *Human Development Index* for Ghana is 0.526, which gives the country a rank of 152nd out of 182 countries, and thereby Ghana still falls under the pillar "medium human development". In addition to life expectancy, infant mortality is often used as a key indicator to describe health care levels. For Ghana, the *Demographic and Health Survey 2008 (DHS)* (Ghana Statistical Service et al., 2009) records under-five mortality as 80 per 1,000 live births, which is a significant fall from 155/1,000 in the 1980s. The report asserts that this is in line with the goals of the *Ghana Poverty Reduction Strategy*, and means the country is on track of achieving the *Millennium Development Goals*' target for childhood mortality (ibid: 140). However, again distinct geographical and socio-economic variation occurs: "Differences in mortality by region are marked, (...) under-five mortality ranges from a low of 50 deaths per 1,000 live births in the Greater Accra and Volta regions to a high of 142 and 137 deaths per 1,000 live births in the Upper West and the Northern regions, respectively" (ibid: 141). And malaria is a leading cause for those childhood deaths, as the DHS summarises the malaria situation in Ghana:

> The Ministry of Health (MOH) estimates that 3 to 3.5 million cases of suspected malaria are reported each year in public health facilities, representing 30-40 percent of outpatient attendance. Of this figure, over 900,000 are children under the age of five. Malaria also accounts for about 61 percent of hospital admissions of children under five years and 8 percent of admissions of pregnant women. It is estimated that malaria accounts for 22 percent of under-five mortality and 9 percent of maternal deaths. (ibid: 221)

Malaria is thus a significant cause of under-five mortality in Ghana, as well as one of most common causes of morbidity, with 30-40% of outpatient attendance being attributable to

malaria. Those high numbers of malaria mortality in children is in accord with worldwide mortality figures from malaria (WHO, 2008b). Malaria further contributes significantly to high anemia rates in children (depending on the region, between 62-98% of children under five were recorded as anemic in 2008 in Ghana; NSS, 2009). While mortality in adults reduces drastically through acquired specific immunity to malaria, which humans develop through continued exposure to malaria parasites and survival of malaria infections, the overall malaria morbidity and mortality remains high. Malaria is hyperendemic in Ghana, meaning the disease has perennial high transmission in the whole country, albeit with seasonal and regional variations. In 2006, an estimated 7.2 million cases of malaria illness were recorded in Ghana, which represents 3% of the total for the WHO African Region (WHO, 2008b: 72).

However, there is another dimension to this high burden of malaria in Ghana. While many people get sick with malaria when infected with *P. falciparum* parasites, people also routinely co-exist with parasites in their blood without developing symptoms of illness. Research from the Brong Ahafo Region in Ghana has shown that parasites were present in approximately 58% of the population at any given time (Owusu-Agyei et al., 2009). The immunity that enables people to tolerate parasites in their blood without getting ill is mainly present in adults, however, "it should be stressed that, even during the period of maximum susceptibility to severe disease, children spend the majority of their time parasitized but healthy" (Marsh, 2002: 256). Thus, the relationship between having *P. falciparum* parasites in the blood and developing malaria is complex[18]. Nevertheless, malaria presents a huge challenge for the under-resourced Ghanaian public health care system, and particularly access to care remains an issue. In this regard the year 2001 brought a significant change in Ghana. The Ghanaian health researchers Irene Agyepong and Sam Adjei summarized the developments aptly:

---

[18] This dynamic will be analysed and discussed in more detail in Chapter 6.3 of the thesis.

> In 2001, Ghana (...) embarked on a process of developing and implementing policy and accompanying programmes for a National Health Insurance Scheme (NHIS) to replace out-of pocket fees at point of service use as a more equitable and pro poor health financing policy. (...) Achieving universal health financial protection in a low-income country like Ghana is a laudable ideal, but technically difficult and challenging. There is currently no low-income country that has achieved universal health insurance coverage. (...) Related to income, the structure of Ghana's economy, with many citizens employed in the non-formal sector and living in rural communities and small towns with poor road access, telecommunications and health service access, is a major challenge. Despite these challenges, Ghana was determined to try. (Agyepong and Adjei, 2009: 152)

The historical, political and financial context as well as challenges of the introduction of a National Health Insurance Scheme (NHIS) in Ghana are analysed in more detail in Agyepong and Adjei (2009). In short, the scheme is regulated through the National Health Insurance Act 2003, and its implementation is financed "by individual premium payments and a 2.5% National Health Insurance Levy to be collected using the same mechanisms as the already existing 12.5% Value Added Tax (VAT). Two and a half per cent (2.5%) of formal sector worker contributions to the Social Security and National Insurance Trust (SSNIT) towards retirement benefits were to be automatically transferred to the national health insurance fund on a monthly basis" (ibid: 156). Premiums vary slightly from district to district, but generally members pay between GH¢7.2 and GH¢48.0[19] yearly, depending on their income. By the middle of 2007, some 47% of the total national population had registered with the NHIS (Mensah et al, 2009), and research indicates that the NHIS is an appreciated

[19] GH¢7.2 and GH¢48.0 is roughly equivalent to £3.28 and £21.86 respectively.

innovation:

> Although 60% of interviewees expressed some frustration about delay in obtaining enrolment or ID cards as well as difficulty in obtaining all prescribed drugs from in-plan pharmacies, all interviewees were happy with the idea of the NHIS. Interviewees were in agreement that healthcare cost is lower now than under the previous system and were satisfied with the quality. (Warhab, 2008)

Overall, however, the previously mentioned bias between socio-economic status and the urban-rural, as well as regional gaps are reproduced in the NHIS. And this has recently led a broad coalition of international NGOs to include Ghana into an international scheme "to support at least seven developing countries to fully implement free care for women and children or to expand free health services to all. The seven countries are Burundi, Ghana, Liberia, Malawi, Mozambique, Nepal and Sierra Leone" (Oxfam et al, 2009:1). The decision to include a fairly well off country like Ghana might be surprising for many, but is justified in the proposal as follows:

> Ghana is sometimes heralded as the success story of insurance-based schemes to provide medical care. However, the reality is very different. The majority of people continue to pay out-of-pocket for their health care needs and the country is way off track in achieving the health Millennium Development Goals. By the end of 2008 only 54% of the population was registered under the National Health Insurance Scheme. Even less had actually received their membership card. The vast majority of insurance scheme members are from higher income groups. (ibid: 5)

There is, thus, no doubt that while the NHIS is a major step towards sustainable and high quality provision of health care for Ghanaians, significant challenges remain and urgently need to be addressed (Oxfam et al., 2009; Agyepong and Adjei, 2009). It has been shown in this section that malaria is one of the major diseases that strain the Ghanaian health care system and endanger the health and lives of Ghanaians. The history and politics of Ghana, its relationship to health care systems and malaria control as well as its social, political and economical implications could of course be discussed in much more depth. I will return to some of the threads of this section at later stages of the thesis. For instance, malaria control strategies worldwide and their implementation in Ghana will be discussed further in *Chapter 4*. In this section, however, the aim was to provide a brief entry point to Ghana as a country as well its malaria situation. In the following section I will provide an overview over the empirical research that this thesis draws on, analyses and discusses in later chapters.

1.4 The empirical body of the work – where, when, how?

This section describes *where, when and how* the empirical research for this thesis took place. I spent two main research phases in Ghana: A first period was from mid September 2007 to mid March 2008, and a second from mid June 2008 until mid August 2008. The main methods of research were semi-structured, problem-centred interviews (Witzel, 2000) and ethnographic participant observations (Lüders, 2004; Jorgensen, 1998). Interviews were recorded when participants agreed and the circumstances allowed, if not detailed notes were taken. After the interview I always wrote a post-scriptum, recording the main themes of the interview as well as observations about the atmosphere of the conversation etc. The ethnographic part of the research was documented by extensive field notes; notes were taken during the ethnographies, written up and supplemented after the work day.

My first two months I mostly spent in the capital Accra, conducting semi-structured, qualitative interviews. The aim was to get an overview of what is happening in malaria control in Ghana, which actors are involved and which strategies get employed. After two months, I had concluded a first round of interviewing policy stakeholders, learned about the National Malaria Control Strategy and had identified projects and places that I wanted to visit.

Early in 2008 I travelled to Agogo, a small town in the Asante-Akim North District in the Ashanti Region, where I spent around six weeks. The Presbyterian Church Hospital (former Basel Mission) in Agogo is home to a research base of the Kumasi Collaborative Research Institute (KCCR), a German-Ghanaian collaboration and the tropical outpost of the Bernhardt-Nocht-Institute for Tropical Medicine in Hamburg, Germany. While staying in Agogo I conducted hospital ethnographies in (a) the hospital in Agogo, where (inter alia) malaria vaccine trials took place at the time; (b) a public district hospital in Konongo-Odumase, and (c) a rural, public health centre in Ananekrom. Here, I explored how malaria treatment is organised and *done* in different settings, with different levels of staffing and equipment. Furthermore, I was able to take part in a three day workshop in malaria microscopy and spent several days observing malaria diagnosis in the clinical laboratory in Agogo Hospital. Some results of the hospital ethnographies and the malaria microscopy workshop are discussed in *Chapter 6*. This part of the research relied on ethnography, participant observation, and many informal and formal conversations with local and international staff as well as patients. The conversations were supplemented with interviews with key staff of the malaria vaccine trials and the general primary health care team of the district. While people were generally amazingly accommodating, helpful and patient with the inept ethnographer, one of my field diary entries from Agogo helps to bring the everyday

challenges of ethnography in a hospital to life:

Agogo, Day 2: I arrive at the 'Under 5 Clinic' approximately at 9am and say hello to Ante Dora, one of the older nurses. She informs me that no doctor is here as yet, so I go to the registration of the patients. In an area separated by a table from the waiting area but on the same level of the clinic (the consulting rooms are a few steps up), one female nurse in a pink dress and a male nurse in white clothes sit behind a table and hand out forms to the arriving mothers. The mothers bring a green book with them, on which one can read 'Child Health Record' and 'not for sale'. After having been registered for the clinic that day, the mothers weigh their child and then proceed to the area behind the table, where the temperature of each child gets taken with one of the three electrical thermometers. Also, the nurses record the height of the children by putting them into a 'measure box', made in Germany and with German descriptions about child height written on it. The children don't like being weighed and measured, they cry easily, many already when the temperature gets taken, the height measuring, however, is especially scary. And to make things worse, a scary white woman (me) sits at the one end of the strange machine next to their feet and looks at them. One child, who sits opposite me in the waiting area, is so scared of me, it starts to cry. The sister laughs and then tells me that the child said it is afraid of me… hmm. I feel like running away, I do not only attract much attention and disturb the smooth running of the clinic, but on top of this make the clinic visit for the children even scarier.

Figure 5: The registration desk at the Under-Five Clinic, Agogo Hospital

I struggled with the fact that I was being disruptive more than anything else. I was inevitably in the way because the clinic was overcrowded and small. Furthermore my skin colour distinguished me immediately from staff or parents present. This feeling of being an intruder, a disturbing presence, was coming and going, sometimes I felt people were happy to share their working lives with me, indeed it seemed to add value to their work that someone was interested in what they were doing and why. On other occasions, however, I was plainly standing in the way and a hindrance to their work. There was not much I could do to make myself useful in the hospital, even though I tried to ease my guilt about this one-sided process by helping out in the small and informal hospital kindergarten for Buruli Ulcer patients in the afternoons. I am sure I was not of much help there either, but it made me feel better; and the children and I certainly had much fun together:

Figure 6: The Buruli Ulcer Kindergarten

I ended my first 6 months in Ghana with several short visits to other malaria control projects. I visited an insecticide spraying project in Obuasi, which is conducted by a major multinational goldmining corporation. I also went to see a second spraying project in three small villages in the Ashanti Region, where George Ayittey, a Ghanaian economist based in Washington, in a private initiative established "Malaria Free Zones"[20]. Generally, I conducted site visits of a couple of days, interviewed key personnel of the projects, as well as informally talking to members of the public about the projects. In Obuasi, I furthermore interviewed representatives of a mining-watchdog NGO on the relation between the mining cooperation, the malaria control project and the public.

---

[20] The malaria free zones are not discussed further here, but for some more information visit: http://www.freeafrica.org/projects/malaria_free_zone.htm

During my second stay in Ghana June-August 2008 I visited the spraying project in Obuasi again, this time for go-alongs with the sprayers and to conduct informal interviews with sprayers and management team members. *Chapter 5* is the result of the work in Obuasi. Additionally, I led a two-week workshop in collaboration with the Geography Department at Kwame Nkrumah University for Science and Technology (KNUST). I offered a one week seminar on the sociology of malaria and qualitative, participatory research methods, with around 10 geography graduates and several lecturers attending. In the second week five of the graduates and I travelled to Ananekrom, where we spent three days. Together we conducted semi-structured group discussions, participatory mapping of mosquito hotspots, participatory photography with community leaders, young mothers and school children. On the last day a community play on malaria prevention and control was performed by school children to the public, the play was devised with the participation of the children; it was rehearsed with and directed by Ganle Kuumuori (KNUST/Oxford).

Figure 7: Impressions of the research stay in Ananekrom, July 2008

Parts of the data from the workshop will be discussed in *Chapter 7*. Finally, I used my second stay to conduct interviews with experts I did not manage to meet during my earlier stay, and visited the second malaria vaccine trial site in Ghana, the Kintampo Health Research Centre – a national institution of the Ghana Health Service of outstanding international recognition. Together with three other African research centres in Mali, Mozambique and Tanzania, the Centre won the prestigious Prince of Asturias Award for International Cooperation in 2008 for its malaria vaccine trials

However, the data coming from my fieldwork stay in Ghana are by no means the only materials I used for my analysis of malaria control, and in developing the argument of this thesis. As elaborated in *Section 1.1* the thesis aims to write an account of malaria that is thoroughly based in the practices of humans, mosquitoes and parasites as together

constituting malaria. But how to access practices of mosquitoes and parasites? The more conceptual questions that arise when writing a more-than-human story on malaria are discussed in *Chapter 2*, here I will focus on the implications that such an approach has for what is considered "empirical material". At this point Annemarie Mol's assertion is useful:

> But surely the first step is to consistently recognise that there are many entanglements in every action. To keep practicalities unbracketed. To treat everything in medicine as a practice. To engage in a praxiography. Praxiographic stories have composite objects. Disease is no different in kind to hospital stays or daily life. Each flows into each other. (...) The praxiographic approach allows and requires one to take objects and events of all kinds into consideration when trying to understand the world. No phenomenon can be ignored on the grounds that it belongs to another discipline. This doesn't make the description easier. (Mol, 2002: 156-8)

"No phenomenon can be ignored on the grounds that it belongs to another discipline" she says. My point here is that not only an interdisciplinary way of working is required, but also a mixed understanding of what qualifies material for inclusion into the analysis. Thus, in the "empirical" chapters of the thesis (3-7), I will use (a) the empirical data from Ghana, but also (b) offer a re-reading of historical analyses on malaria and its control, interweave these materials with (c) scientific work on malaria, and (d) policy and media reports. I propose to approach all these four types of materials as constituting the empirical basis of this thesis. Materials (b), (c), (d) will receive as much analytical attention as the ethnographic and interview material from Ghana, and the collection and analysis of this material has been generated by a thorough research process spanning from autumn 2006 until early 2010.

This has been done through keyword searches on *PubMed*, a major scientific literature database[21], the subscription to several malaria email list-serves, such as *Roll Back Malaria's Malaria in the News* service, the weekly *Malaria World* email update service, the UK government *They Work For You* information service, Google Reader RSS subscriptions and Google Alerts. Furthermore, I attended the two-monthly meetings of the *All-Party Parliamentary Malaria Group*[22] (APPMG) in the Houses of Parliament, London. The APPMG group is a voluntary activity of some members of parliament and open to the public. It was set up in 2004 and aims to provide "a forum where solutions, urgent and long term, can be promoted" (APPMG, 2007). Participation at those meetings was an excellent opportunity for me to deepen my understanding of current discourses and debates around malaria on a policy level. It enabled me to hear influential policy makers on malaria, working both in the UK and at an international level (WHO, RBM, Bill and Melinda Gates Foundation etc), who were invited to present to the group.

1.5 Overview of Chapters 2-8

The following *Chapter 2* will discuss and assemble theoretical, conceptual and methodological resources for my analysis of malaria in Ghana. *Chapter 3* provides a historical analysis of malaria control interventions and strategies, focusing particularly on the first *Global Malaria Eradication Campaign*, 1957-69. *Chapter 4* portrays contemporary approaches and configurations of malaria control, and provides an overview of malaria control tools. *Chapter 5* analyses one concrete malaria control intervention in Ghana: insecticide spraying in a gold-mining town. *Chapter 6* is concerned with definitions of malaria. The chapter aims to locate malaria by way of a discussion of four practises of malaria control. *Chapter 7* examines a second malaria control intervention: it discusses the

---

[21] http://www.ncbi.nlm.nih.gov/pubmed

[22] http://www.appmg-malaria.org.uk

social, economic and ecological realities of bednets. *Chapter 8*, the conclusion, reflects on the main conceptual arguments of the thesis and discusses practical implications for imagining and practising malaria control.

Blank Page

Chapter 2:

Other-than-human geographies in a postcolonial world

What happens when nothing is reduced to anything else? What happens when we suspend our knowledge of what a force is? What happens when we do not know how their way of relating to one another is changing? What happens when we give up this burden, this passion, this indignation, this obsession, this flame, this fury, this dazzling aim, this excess, this insane desire to reduce everything? (Latour, 1993:157)

Most social science literature on malaria aims to directly inform malaria prevention, management and control by "revealing who to target, what behavioural, economic, social, and other contextual barriers must be overcome in order for insecticides and drugs to have their desired effects" (Mwenesi, 2005: 293). Studies for instance explore socio-economic aspects of disease (Gallup and Sachs, 2001; Teklehaimanot, McCord and Sachs, 2007; Asenso-Okyere and Dzator, 1997) or knowledge and perceptions of malaria (Williams and Jones, 2004; Geissler et al., 1995; Miguel, et al., 1999; Nieto et al., 1999; Tarimo et al., 2000). In Ghana, there has been a substantial increase in social science studies on malaria in the 1990s, which directly informed malaria policy and practice through the National Malaria Control Programme (see Gyapong and Garshong, 2007). Studies focused on the use and acceptance of bednets (Agyepong, 1992; Aikins, Pickering and Greenwood, 1994; Mwenesi, Harpham and Snow, 1995; Gyapong et al., 1996; Binka and Adongo, 1997; Muela, Haussman, Ribera and Tanner, 1998), on drug forms (syrup vs tablets), labelling, pre-packaging and its effect on adherence to therapy (Agyepong et al., 2002; Yeboah Antwi et al., 2001; Ansah et al., 2001), on home management of malaria (Browne et al., 2001), as

well as the question if schoolteacher education on malaria impacts on absenteeism (Afenyadu et al., 2005; all references after Gyapong and Garshong, 2007).

While such "implementation research" (Gyapong and Garshong, 2007) is very valuable, such studies mostly adopt so called behaviourist or factoral models of disease[23], and assume a separation between science and culture. Or, as Melissa Parker and Ian Harper evaluate the "mainstream public health literature":

> There is little, if any, recognition of the fact that what appears, in any specific context, to be 'scientific knowledge' has emerged and been shaped by multiple and overlapping ways of thinking and seeing embedded in complex social processes. These processes include power relations and economic hierarchies as well as conceptions generated by previous health interventions (Parker and Harper, 2006: 1)

Furthermore, and even within more critical work on health care and the relations between science and society, the division of labour is clear: social science addresses the human factor, while scientists concern themselves with parasites and mosquitoes' impact on malaria. In work on disease coming from the social sciences the explicit agency lies with humans: Most of this work documents how human efforts at disease control and management have been organised, why and how they are successful or fail, and how things could be improved. The social is thus reduced to humans and their agency. However, this does not do justice to how the disease and particular geographies of it emerge. If we recall the story about emerging resistance and its implications for Ghanaian patients told at the

---

[23] Parker and Harper define: "A 'factorial' model of disease in which social and cultural factors are deemed to be just one of a number of factors to be considered alongside a range of other factors. These include biological features of the infecting organism; nutritional factors; environmental factors; psychological factors; and genetic factors influencing susceptibility to disease at an individual and population level" (ibid., 2006: 1).

beginning of this work, we might ask how we could write a social scientific account of malaria that takes such processes seriously? A social scientific account that neither assumes a separation between science and culture, nor between nature and culture; but rather considers all such factors together, and analyses the complex linkages and interplays between heterogeneous and different forces in malaria control? How might we write an account of malaria, where "nothing is reduced to anything else", as Bruno Latour has put the general question in *Irreductions* (Latour, 1993: 197)?

Recently, some work on malaria has started to analyse the interplay between human and nonhuman forces more explicitly (Turnbull, 1998; Mitchell, 2002; Langwick, 2007). In this work humans and nonhumans are considered together; in David Turnbull's words malaria is understood "as a complex of interactions, providing the conditions for constituting the disease as a specific natural entity through a social process of selective definition of malaria and response" (Turnbull 1989: 286). Malaria here is drawn into a complex network of interactions, it emerges from an encounter between three species and their respective practices. However, if malaria is understood to be the outcome of a three species encounter, this requires us, the social scientists, to also include parasites and mosquitoes in our inquiry. But how to do this conceptually? How might we conceptualise malaria as a multiple and shifting disease? How might we write accounts of malaria, where mosquitoes, parasites and humans are considered together, all of them having agency?

While the following five chapters will engage these themes historically and empirically, this chapter works through those questions conceptually. Drawing on resources from geography, science studies and postcolonial studies, and by positioning my work in this interdisciplinary matrix of literatures, I hope to establish an ethos –conceptually, methodologically and ethically– for this thesis. I will elaborate on how we can practice attentiveness to

entanglements with nonhumans, and thus make certain versions of malaria (more) visible. The chapter aims to open up a space of possibility for other kinds of accounts on malaria, for malaria understood as practice constituted by humans, mosquitoes and parasites together. In order to prepare such stories of malaria and its control I will draw on a range of theorists – using their ideas to bring forth, enact, and help me engage particular versions of malaria in Ghana. It is those conceptual resources and versions of malaria that I will draw on and return to in subsequent chapters while thinking through the empirical material mobilised in this thesis.

In *Section 2.2* I will take a group of writers, who have engaged the question of nonhuman agency, in order to specify how we can think through and write about human-nonhuman encounters. The section asks how we can grant agency to nonhumans and trace how nonhumans impact on human, health and history, as well as contributing to the definition and re-definition of disease control. I will discuss recent work from human-nonhuman geographies (Timothy Mitchell, Steve Hinchliffe et al, Sarah Whatmore, Nick Bingham) and philosophy (Jacques Derrida). It will be analysed how these authors have sought to work together human and nonhuman practices, and through this develop our sensibilities for nonhuman traces in the world. Overall, the section suggests that considering human and nonhuman actors symmetrically might enable a novel understanding of sociality as an intermingled and complex process within human-nonhuman worlds.

Nevertheless, I argue that such work can risk overemphasising an ethos of conviviality and friendship between humans and nonhumans. Such an emphasis does not capture disease dynamics of a deadly disease like malaria, and, for this reason, I will in *Section 2.3* take something from a group of writers, who have sought to take human encounters and entanglements with not-so-cosy encounters seriously. I will engage the works of Myra Hird,

Joshua Lederberg, Joost Van Loon, Michel Serres and Donna Haraway, gathering resources to navigate spaces of interspecies disease encounters. The section questions if beneficial and harmful entanglements with nonhumans can be easily distinguished. I suggest that reaffirming stark boundaries between humans and nonhumans might be counterproductive in disease control. Rather, following Donna Haraway, it might be more productive to focus our attention on the *process* of engaging with nonhumans, on the *how* of disease control.

If we aim to understand malaria control and its configurations today, there is a third important aspect that needs to receive attention in conceptualising malaria. The disease is not only the outcome of an encounter between humans and harmful nonhumans, but its epidemiology is also shaped by marginalization and poverty. Malaria takes its highest toll on the poorest populations on the planet. Its control in sub-Saharan Africa is dominated by international donors, and malaria co-evolves with the politics of postcolonial economies. The disease has, thus, to be thought of not only as a human-nonhuman, but importantly also as an intrahuman encounter. Thus, *Section 2.4* will explore how the relation between humans and animals has so far been conceptualised within a postcolonial context. This section will focus on the ethnographies and theoretical considerations of Timothy Mitchell, Hugh Raffles, Charis Thompson, JoAnn McGregor and Gayatri Spivak. I argue that drawing postcolonial concerns into human-nonhuman encounters is imperative for understanding malaria control. Postcolonial theory alerts us that paying attention to the role of animals involves the risk of neglecting injustices between humans. I, thus, argue in this section that an attempt to capture human-nonhuman relations needs to be layered with a careful analysis of human-human relations.

Fourthly and lastly, to write an account of malaria that takes the encounter between humans and nonhuman as well as intrahuman encounters seriously, requires us to rethink what should be included in social analysis. *Section 2.5* brings together the conceptual questions that have been raised in this chapter, and discusses their practical and methodological implications. The politics of ethnography (Jim Clifford, George Marcus, Talal Asad) are brought in conversation with methodological elaborations from science and technology studies (John Law, Ingunn Moser, Annemarie Mol). I explore which methods and sets of sensibilities might able us to analyse postcolonial intrahuman, as well as human-nonhuman encounters together. I propose to understand research methods and academic writing itself as generative and as enacting realities, and frame the contribution of this thesis as an intervention – both an intervention into concrete malaria politics, as well as into social theory. To recap, by positioning this thesis within a matrix of other-than-human geographies, science and technology studies as well as postcolonial studies, I hope to set the tone and scene for my engagement with the histories of malaria, current policy constellations of malaria control as well as the three empirical chapters (6-8). The next section will now discuss nonhuman agency and its recognition within social theory.

2.1 Can the mosquito speak?

With regards to thinking through nonhuman agency in disease control, Timothy Mitchell's text *Can the Mosquito speak? Para-Sites of Capitalism* (2002) offers a good starting point. The article is concerned with Egypt's invasion of the *Anopheles gambiae* and the occurrence of a malaria epidemic in the 1940s. As his title suggests, Mitchell aims to write a symmetrical story, where not only human actors, but also mosquitoes, war, the building of dams, irrigation schemes and the industrial production of pesticides are at stake and have 'a say' in the malaria epidemic. The notion of "symmetry" builds on "the principle of generalized symmetry" as developed within actor-network theory (ANT). Initially, David Bloor within the

strong programme in the sociology of scientific knowledge developed the "principle of symmetry" (Bloor, 1981). The concept was later re-worked by Michel Callon into "the principle of generalized symmetry" (Callon, 1986). Bruno Latour in his *Reassembling the Social: An Introduction to Actor-Network-Theory* (2005) usefully summarises the concepts and defines it as follows: "ANT is not, I repeat is not, the establishment of some absurd 'symmetry between humans and nonhumans'. To be symmetric, for us, simply means *not* to impose a priori some spurious *asymmetry* among human intentional action and a material world of causal relations" (ibid: 76). In this vein, Mitchell's analysis explores the various interactions that led to the outbreak of the disease (2002: 22); his story is a story about colonialism, postcolonial independence efforts, the Second World War, the development of industrial agriculture and capitalism in Egypt, as well as international attempts to eradicate malaria:

> No one writing about Egypt in this period describes this interaction. There are studies of military tactics, irrigation methods, Anglo-Egyptian relations, hydraulic engineering, parasites, the sugar industry, and peasants. But there are no accounts that take seriously how these elements interact. It is as if the elements are somehow incommensurable. They seem to involve very different forces, agents, elements, spatial scales, and temporalities. They shape one another but, yet their heterogeneity offers a resistance to explanation. (ibid: 27)

Mitchell describes this as a shortcoming typical for social sciences, social theory according to him always relates particular cases to larger patterns, processes or bigger narratives (Mitchell, 2002: 28). Further, Mitchell states social sciences seem to know before who the protagonists in their stories are going to be (ibid: 29). This to him is due to a binary divide between nature and culture, where nature is depicted as "essentially passive externals"

(Mitchell, 2002: 29). Mitchell's text aims to break with this tradition in the social sciences by tracing a connection between capitalism and the mosquito: "And it was through those same circuits – dams, irrigation, sugar cultivation – that the mosquito had entered Egypt" (33). The parasite therefore not only benefits from the human body as a host, but also from the infrastructure that capitalist interventions in Egypt provided. And as Mitchell suggests with his word play *Para-Sites of Capitalism* it not only becomes parasitic on humans, but also on capitalism. This style of analysis is crucial to him:

> Overlooking the mixed way things happen, indeed producing the effect of neatly separate realms of reason and the real world, ideas and their objects, the human and the nonhuman, was how power was coming to work in Egypt, and in the twentieth century in general. (ibid: 52)

Mitchell's work thus aims to open up the social sciences for a "mixed" conception of social processes. Such thinking is particularly important for thinking through the interplay between human malaria control interventions and nonhuman forces at play. As we have seen in the introduction biological resistance is redefining malaria control. There is, thus, a decidedly nonhuman agency at play here, which –if to be taken seriously in social scientific writing– requires us to conceptualise the social as a not-only-human endeavour. This, however, involves rethinking the divide between humans and nonhumans. In this regard Jacques Derrida offers fruitful reflections on the politics of human-animal relationships, and argues that finding ways of granting agency to nonhumans is crucial for responsible academic practice.

At the centre of his argument is the neologism 'animot', a fusion of the French words 'animal' and 'mots' (words). This aims to bring the notions 'animal' and 'words' together. Secondly, if

one pronounces 'animot' in French it sounds like 'animaux', the plural of animal. So, 'animot' is not only a combination of 'animal' and 'word', it also rejects a depiction of animals in the singular, authoritative 'the Animal'. Furthermore, with 'animot' Derrida attempts to draw attention to the multiplicity of organizations or relations – a complexity that escapes description:

> Beyond the edge of the so-called human, beyond it but by no means on a single opposing side, rather than 'the Animal' or 'Animal Life' there is already a heterogeneous multiplicity of the living, or more precisely (since to say 'the living' is already to say too much or not enough) a multiplicity of organizations of relations between living and dead, relations of organization or lack of organization among realms that are more and more difficult to dissociate by means of the figures of the organic and inorganic, of life and/or death. These relations are at once close and abyssal, and they can never be totally objectified.
>
> They do not leave room for any simple exteriority of one term with respect to another. It follows from that one will never have the right to take animals to be the species of a kind that would be named the Animal, or animal in general. (Derrida, 2002: 399)

Hence, 'animot' inserts 'word' to 'animals'. The 'word' is important here, because "it would not be a matter of giving animals a (human-like) voice, but recognizing it as from 'wholly other origin'" (ibid: 382). It is not a matter of making animals human-like, but rather of removing the abyss, the "single, indivisible limit" that has been produced between humans and other-than-humans. Derrida understands the establishment of such a boundary as a violent process, which enables a seemingly clear definition of what it means to be human, but also produces a harsh division between humans and other-than-humans. According to

Derrida this harsh boundary has been and still gets (re)produced in a long history of philosophical thought.

Derrida's point about 'words' implies that the question is not to determine if mosquitoes and parasites have agency, it is not important if the mosquito can speak or not. Rather, following Derrida, the task would be to learn being attentive to mosquitoes' and parasites' ways of expressing themselves, of manoeuvring in the world. Thus, recent work has moved away from examining if the animal can speak to training our human senses in reading other-than-human traces in the world. As, for instance, Steve Hinchliffe and colleagues in their project *Habitable Cities* (2005) explored, this involves a transformative process in the researcher, it is about developing "a different sensibility" to "be affected" (ibid: 648). The aim is not to simply map out traces of, in their case, water voles as a means to represent them. Rather they are interested in complex interactions and "interweavings" of other-than-human and human worlds, in creating "entanglements" or "new types of encounter" (ibid: 655). This is different from "representational political ecologies that inscribe thick boundaries" (ibid: 655); representation here is not seen as "neutral process leaving the represented or those doing the representing unaffected" (ibid: 650). Rather Hinchliffe et al's analysis is "about changing engagements. In short, ecologising politics is more interested in ontological struggles than in subtle shifts in our epistemology" (ibid: 651).

Conceptualising and reimagining our ontological entanglements and engagements with the nonhuman world implies ethical decisions. Posing the question of how we relate to nonhumans not only fleshes out the specifics of a relationship, but also asks if this is a fair and just engagement? And thus, for Sarah Whatmore (2002), this move towards creating other types of encounters is inherently connected to a form of "relational ethics", a form of ethics that works through a multitude of relations without drifting into a pluralism of living

tolerantly next to each other, unattached and unaffected. Thus, such affective engagements are not about collapsing into unity, rather engagement is seen as a negotiation which requires respect; respect not only in moments of connection, but also when faced with misunderstanding or aggression. Ultimately, it is about acknowledging difference and the appreciation of precious moments of sameness.

In a similar vein Nick Bingham conceptualises the meeting of butterflies, bees and bacteria as a form of friendship (Bingham, 2006). Engaging Derrida's ruminations on friendship (Derrida, 1997), Bingham conceptualises human and other-than-human friendships as a "willingness and capacity to be affected" (ibid: 489). In distinction to classical concepts of friends as another self, Derrida thinks "of the friend in terms of distance rather than of proximity, in terms of irreducible alterity rather than a community of shared concerns, in terms of strangeness rather than of familiarity" (Caputo cited in Bingham, 2006: 488).

Telling stories of very different and often overlooked engagements with biotechnology Bingham too works towards other modes of engaging with difficult questions around other-than-humans and the impact of cutting-edge technologies on the environment and us. He does so by tracing how beekeepers, organic farmers and amateur entomologists as well as the Monarch butterfly in the USA, bees in the UK and the *Bacillus thuringiensis* happen to take part as well as get enrolled by the world into the GM debate. This move towards unexpected involvements "resist the easy shortcut" (ibid: 496) of

Retreating, in other words, to the pure and simple space where Nature – the realm of the nonhuman – should be left to Science, and Society – the realm of the human – should be left to Politics. Instead, we need to remain faithful to our earlier wager that it is from the muddle of the middle that we have everything to

> learn about living, and hope that this approach will also yield insight when we are considering issues of living together too. (ibid: 496)

This is the location, from where Bingham starts his journey, and he argues that with such reconfigured notions of friends we might "find a way of thinking about these 'remarkable things' (McGregor, 2005) that grants them positive ontological differences in their own right" (Bingham, ibid: 492), which, as Bingham hopes, might lead us towards "another (cosmo)politics of friendship" (ibid: 493).

The approaches that have been discussed in this section open up the "politics of nature" (Latour, 2004), of thinking sociality beyond a neat distinction between human and nonhuman processes. However, so far, the explorations of human-nonhuman relations have mostly concentrated on animals with "nonhuman charisma" (Lorimer, 2009), or in other words, animals with which co-habiting is at least possible if not mutually beneficial. Even Bingham's "societies of friends" are still based on positive encounters between humans with other-than-humans as e.g. objects of beauty or helpful friends in pest control. Co-habiting with such "remarkable things" might be easier than encounters between mosquitoes, parasites and people, where the outcome for humans is disease or even death. Taking this seriously is, however, central for an engagement with malaria, and forms a core concern of this thesis. Thus, the next section thinks through if – and if so, how – one can imagine other-than-human friendships with mosquitoes and parasites? This question will be the subject of the following section.

2.3 Parasite Politics

When it comes to the less pleasant species of nature, mosquitoes – while they might not be feared as poisonous animals (such as spiders or snakes) or big predatory animals (such as

tigers or sharks) – they would certainly score high on a list of least liked species. Mosquitoes are popularly understood and experienced as nuisance or pestilence rather than friends:

> Mosquitoes – who needs them? (...) And man are they a pain in the ass! Swarms of them buzzing around your head, driving you nuts. They are in your eyes, your ears, even your mouth. They are nibbling at your ankles, the back of your knees. Or maybe that single mozzie keeping you awake for hours as it dive bombs in your bed. Giving you those itchy bites. Ruining the picnic, the view, the garden. (Swift, 2006: 7-8)

It seems then that mosquitoes might not qualify well as nonhuman friends, with whom we would like to encourage different entanglements. If, on top of the nuisance, they also carry the malaria-causing *Plasmodium* parasite the verdict usually becomes very clear. Mosquitoes and parasites are humans' enemy and shall at best be eradicated. This is very much the mode in which malaria control has dominantly been conceptualised and practised – both in the past (see *Chapter 3*) and more recently (see *Chapter 4*). However, as we have seen in the *Introduction,* people also routinely co-habit with parasites; 58% of the Ghanaian population has malaria parasites in their blood at any given time, and without showing signs of illness (Owusu-Agyei et al, 2009). Furthermore, the parasites can not only be found in our blood, but *within* our blood cells, and the immune system has developed different ways of living with malaria: partial immunity as well as adaptive diseases such as sickle-cell anaemia. Humans are thus fundamentally entangled with mosquitoes and parasites, and the effects of this co-existence are ambivalent, not clear-cut. The entities involved in the interaction that is malaria are themselves composite bodies, and are thus always already multiple in some sense. This raises the challenging question, what is really at stake for thinking about being with others? How can we conceptualise such a cohabitation of human-

mosquito-parasite and its effects? This is a question that has also been eloquently raised by the biologist Joshua Lederberg:

> We must now remind ourselves that much of the biological composition of our bodies consists of genomes other than human. Multitudes of bacteria and viruses occupy our skin, our mucous membranes and our intestinal tract. They are likely to play a much larger role in developing – and resisting – disease than we realise. Understanding this cohabitation of genomes within the human body – what I call the microbiome – is central to understanding the dynamics of health and disease. (Lederberg, 2003: 1).

In her recent book Myra Hird (2009) too is interested in humans' cohabitation with bacteria. She explores "microontologies" – as she terms it – and her starting point is that humans are not central to the earth, but that rather "bacteria run the show" (Hird, quoting the biologist Lynn Margulis). This not only changes the location of her research (starting from bacteria rather than humans), but also impacts on the subject-object relation/distinction:

> Thus my encounter with bacteria must somehow recognize that 'I' am bacteria, that bacteria are us. It must also somehow take on board that bacteria are not easily separated – they are notoriously ungracious when scientists attempt to culture them (i.e. isolate them from their communities in petri dishes) – and that our symbiotic and symbiogenetic ancestry means, as Haraway recognizes, that it is symbionts-all-the-way-down. (ibid: 26)

Thus, Hird starts from the observation that there is no easy distinction between us and bacteria. The boundaries between 'good' and 'bad' microorganisms are not stable but

depend on the composition of the wider biological environment as well as competitiveness of other present species. Disease and health are dynamic and depend on various complex factors. Mosquitoes, parasites and other microorganisms furthermore have to be seen as "evolutionary success stories" (Swift, 2006), who have been on this planet before us, and as Hird puts it: "Humans might ultimately render the biosphere inhospitable for humans and other animals, but this shifted biosphere will certainly survive our extinction" (2009: 129).

Similarly, for Lederberg a disease eradication approach is counterproductive. To him the question is not if we want to cohabit with microorganism –such as protozoan parasites and their vectors, the mosquitoes– but it rather becomes a necessity to:

> live in a cooperative arrangement – a truce – with those microbes that don't kill us (...). Another implication is that, philosophically, we have to be very suspicious about the concept of eradication, of nailing a stake through the heart of bacterial infection once and for all. In such a world, we would not have the stark experience of accommodating infectious stimuli and become more vulnerable (ibid: 4).

Lederberg's suggestion to start thinking about human health in terms of cooperative arrangements, and a "truce" between human's and microorganisms interests differs significantly from common disease control narratives that are focused on defeating the infectious agent, preferably once and for all. Examples of this are various disease eradication programmes – such as smallpox, tetanus or malaria eradication efforts (see *Chapter 3 and 4*). Thinking through the possibilities of such cooperative arrangements, however, first and foremost requires us to carefully think through human relationships with other-than-humans that are potentially harmful to us. Following Hird, this requires to take

seriously that we are (made up of) microorganisms, as well as to recognize that human life is inextricably enmeshed with, and dependent upon the lives of those tiny creatures.

In this sense we could say that we as humans live in a constant parasitical state with the earth. In such a reading parasitism is understood in its biological definition, where – as Joost Van Loon (2000) nicely explains – biological symbiosis includes parasitism and describes a "mutual interdependence between two distinct species" (ibid: 242). According to Van Loon the outcome of symbiosis is highly creative, while the stages in between combine elements of exploitative, aggressive behaviour as well as elements of solidarity and mutual benefits. Van Loon argues that *Parasite Politics* (as his piece is entitled) are complex and ambiguous. And, such an understanding of life has implications for ethics too:

> Parasitism engages ethics on a rather different plane than that of survival. It is not the survival of a particular symbiotic community that is at stake, but its transformation, its becoming-other. (...) In becoming-host the parasite is the most effective ethical Other to engender a sense of 'community-in-difference'. (2000: 252)

Be it in intra-human, parasite or mosquito communities or in one of their many hybrid encounters, where separation becomes difficult at a closer look – such "communities-in-difference" are the everyday of malaria politics. As we will discuss in more detail in *Chapter 6* practices of malaria control are multiple and moving. For instance, as we saw in the introduction, drug resistance from South East Asia travelled in human bodies to Africa, transforming malaria treatment and control on the continent. Thus, the discussed concepts and more generally a social theory that it is open and attentive to the unexpected,

unexplainable and to nonlinear flows of matter-energy, of human and other-than-human forces is crucial for thinking through the challenges that malaria control poses in practice.

Processes out of control, such as unexpected interference, excess or turbulence are also the theme of Michel Serres' philosophical explorations around parasites. In his book *The Parasite* (1980) Serres defines the parasite as the "uninvited third" in a dyadic relationship. Parasites cause disruption, destabilise an established system; in Serres' words they create "noise".

> Parasites on the other hand are responsible for an unequal exchange—the disruption of that balance. In any case, the parasite takes something without giving something back in return. And the host gives without receiving something in return. The consequence is a completely unjust situation. Why are there such unfair players? Why does the principle of complete injustice exist? The answer to this concerns not only economic exchange, but also the fundamental question about life as such. It all revolves around an interesting natural law. There are cells in our intestines that facilitate digestion. All of these cells originate from parasites—the same parasites that killed our ancestors, and that have learned from this to become symbionts. This is evolution. (Serres in Wiek, 2008)

In this quote the two dynamics of parasites are encapsulated – the potential for positive change through forming an alliance, symbiosis and thus evolution; and the negative change through taking without giving back, or even worse through causing disease as giving back. This is the parasite's ugly gift if you like. But how are we to deal with unpleasant nonhumans, such as parasites and mosquitoes, if eradication attempts are futile (see *Chapter 3*) or – following Lederberg – might even be counterproductive?

In this regard Donna Haraway's recent work is instructive. In her book *When Species Meet* (2008) Haraway explores – mainly through her own bodily engagements with her dog-companion – how we can conceptualise life with other-than-humans beyond friendship versus killing narratives. In this context she engages with Derrida's work on animals[24] in order to think through *response-ability*. For Derrida it is the binary established through the Animal that renders animals killable, and transforms them into an object in the logic of sacrifice, where only humans can be murdered; the Animal, however, never able to respond only to react, can be killed (or in contemporary policy language: culled). Haraway in her work builds on this, and argues for, as well as shows, the complications of response – both of humans and, in Haraway-speak, critters. She argues that taking response seriously means to not render animals killable; she refigures 'thou shall not kill' in 'thou shall not make killable'. Through this she emphasises the process of relating and asks us to pay attention to *how* we kill. She wants us to learn to *kill responsibly*, because:

> The problem is actually to understand that human beings do not get a pass on the necessity of killing significant others, who are themselves responding, not just reacting. (...) Try as we might to distance ourselves, there is no way of living that is not also a way of someone, not just something, else dying differentially. (...) It is not killing that gets us into exterminism, but making things killable. (ibid: 80)

If one understands that animals are not killable, there is an obligation to respond; to realise that there might be a necessity, but that there is never sufficient reason to kill. For Haraway – philosophically and practically, it is hence all about the ability to respond, about *response-*

---

[24] Donna Haraway refers to Derrida's work on the question of differences and boundaries between humans and other-than-humans (Derrida, 2002 as discussed I section (1)). While she disagrees with Derrida's engagement with his cat in the article – she claims he "failed a simple obligation of companion species; he did not become curious" (ibid: 20) – she nevertheless finds his philosophical elaborations useful and re-works them for her intervention.

ability. This response, however, is not to be taken as symmetrical, "response cannot emerge within relationships of self-similarity" (ibid: 71). Importantly (and often misunderstood) Donna Haraway is here not in conflict with the "principle of generalized symmetry" (as it has been introduced in *Section 2.1*). As Bruno Latour points out: "(T)he principle of symmetry aims not only at establishing equality – which is the only way to set the scale at zero – but at registering differences – that is, in the final analysis asymmetries – and at understanding the practical means that allow some collectives to dominate others" (Latour, 1993: 107/8). It is rather proposes that, in order to register asymmetries and elisions, we need to step back from pre-established orderings and consider human and non-human traces in the world together. Or, In Haraway's words it is to allow for and acknowledge response, to be response-able, and to find ways of "sharing suffering" between humans and non-humans (Haraway, 2008: 69ff).

However, sharing suffering might be of less concern when we think about malaria than ending suffering. Clearly (and in Haraway's own spirit), responsible engagements with more unpleasant species, such as mosquitoes and parasites, look very different in practice than meetings with pets. In the face of high malaria mortality and even higher morbidity rates all over the world, but particularly sub-Saharan Africa, the crucial question is not if we should or should not kill. Following Haraway, it is rather important to detail how we kill. This means that the analytic attention has to be on the process, on the generative moment that enacts malaria control assumptions into action, into lived reality. And in this sense Haraway's concept of *killing responsibly* as an approach to human-nonhuman encounters is crucial for my empirical analysis of malaria control. It provides a conceptual lens for the empirical chapters and enables me to ask in each chapter (i) *how do humans kill* mosquitoes and parasites, (ii) *how do we react* to the mosquitoes' and parasites' response *and (iii) who decides* on and designs the interventions?

2.4 Intra-human encounters: agency in a postcolonial world

This last question brings me to another important element of conceptualising malaria. The disease is not only a complex human-nonhuman encounter but also a human-human encounter. Malaria has been analysed as a disease of marginalisation and poverty (e.g. Worrall et al, 2005), and is defined by its socio-economic geography; for instance the WHO estimates that 90% of malaria deaths occur in sub-Saharan Africa (WHO, 2008b). That sub-Saharan Africa shoulders the majority of today's malaria burden has much to do with the quality of sanitation, roads and housing; breeding in pools of stagnant water, mosquitoes spread on the political periphery – they are found anywhere the pavement ends. Tied to narratives of neglect and development malaria interventions are today overwhelmingly funded through and designed by Western philanthropic organisations and public-private partnerships (for more detail see *Chapter 4, 5 and 7*). Mostly, thus, the encounter between mosquito, parasite and human is mediated by and controlled from people living far away from the immediate danger of a mosquito bite. The people who encounter malaria in their bodies often have little say in determining how mosquitoes, parasites and malaria are controlled (for more detail on this see *Chapter 4 and 5*). This raises questions about agency and social (in)justice in a postcolonial world. How might we conceptualise and understand malaria politics as emerging in post-colonial Ghana?[25] Who decides about the design of malaria control measures, and how are human-human encounters enacted in and through malaria control?

If Timothy Mitchell's complex account of malaria in 1940s' Egypt has protagonists, it is the *Anopheles* mosquito and an Egyptian capitalist plantation owner, whose business circuits

---

[25] "Recent theorists have tended to use the hyphenated term 'post-colonial' to signify the historical period following the end of European colonialism. Meanwhile, the unhyphenated 'postcolonial' has come to be used in a much broader manner to signify the wide range of discourses, ideologies and intellectual formations, which have emerged from cultures that have experienced imperial encounters". (Newell, 2006: 3)

contributed and benefited from the massive Aswan damn as well as the growth of the fertilizer industry at the time. Both endeavours Mitchell portrays as not only intermingled with the mosquitoes' flourishing in Egypt, but also as tied up with British and US American imperialist politics at the period. Likening the mosquito, the capitalist as well as the European armies to colonizing invaders, Mitchell tells a story where political actors are not only human – they can be technical (the dam), biological (the mosquito), chemical (fertilizer), earthly (water and breeding places) and human. And so a picture of the malaria epidemic is emerging where (colonial) power struggles and (agricultural) engineering projects contribute as much to the epidemic as the biology and ecological habitat of the mosquito and malaria itself. Mitchell, thus, shows how colonial economic politics and the politics of nature are profoundly entangled with each other.

In his captivating ethnography *In Amazonia* (2002) Hugh Raffles too evokes the fluvial landscapes of the Amazon as an outcome of intertwined histories of humans and nonhumans – of waters, humans, insects sharing a space; creating, re-creating and shaping ecologies. By rendering the rivers of Amazonia as constantly in motion, as the outcome of laboured relations Amazonia also becomes a political place. Nature in Amazonia is not untouched, pristine wilderness, rather human exploration and exploitation are as much part of nature as the flows of water – politics and nature are intertwined, are "dynamic and heterogenous, formed again and again from presences that are cultural, historical, biological, geographical, political, physical, aesthetic and social" (ibid: 7). And by doing this Raffles (re)writes "a natural history" that is far from a-political. The politics evoked here are always in process, places are made and re-made by a variety of forces – they emerge "in the flow of becoming" (Raffles, 2002). As Bruce Braun in his review of the book has put it:

Despite his presentation of the book as only a natural history, the text insistently works away at the most pressing questions of the day. They are about the practice of place and nature, about the mixing of labor and the earth, about Marx and Williams and how we read them. (...) They are about writing history and writing ethnography, about passion and affect, politics and power. (Braun, 2005: 350-1)

In her analysis of a workshop on elephant conservation in Southern Kenya Charis Thompson (2002) also asks how actors and knowledges align and enrol each other in the making of political decisions. Thompson proposes that in the workshop different philosophies of nature compete against each other; the clash of scientific knowledges – in this case of conservation field science and animal behaviour studies – as well as governmental positions and the role and involvement of local communities in past and present decision making processes were discussed and negotiated. Eventually, one stance won over the others: "the model instituted (...) triumphed when they managed to connect but not completely convert or align, more stakeholders to their "side" of the scientific dispute. Critical to this was the creation of enough space to engage without running roughshod over other moral universes" (ibid: 186). In her account Thompson, thus, puts emphasis on philosophies of nature and the micro-processes of politics. To her, understanding how different human and nonhuman actors are mobilised is crucial. This grants human as well as nonhuman processes space in the making of politics, and enables us to analyse those processes together – in "the mixed way things happen" (Mitchell, 2002).

However, writing animals into postcolonial relations has so far been a rather rare pursuit: "postcolonial studies has shown little interest in the fate of the nonhuman animal. In identifying the costs borne by non-European "others" in the pursuit of Western cultures'

sense of privileged entitlement, post-colonialists have concentrated upon "other" humans, cultures, and territories but seldom upon animals" (Armstrong, 2002: 3). Armstrong asserts that one reason for this might be that attention to animals risks "trivializing the suffering of human beings under colonialism" (ibid). In an analysis of human-crocodile relations in postcolonial Zimbabwe, JoAnn McGregor (2005) elucidates the pitfalls of analysing human-animal relationships within complex postcolonial configurations of power:

> The reproduction of hostile local attitudes to wildlife needs to be considered in the light of the material interactions between particular wildlife species and human livelihoods in local situations where dangerous animals do not appear as the 'marginalized other', but benefit from state and international protection and have been accorded significant and expanding space. (...). The effects of the crocodile's redefinition and recovery in the case of Lake Kariba underline the importance of considering postcolonial situations in the 'South', where making physical and imaginative space for wildlife can produce severe conflicts with marginalized social groups, yet where the human costs of these interactions can be hidden. Post-colonial relations of power, and the precarious nature of local livelihoods can pose a profound challenge to the idea of 'bringing the animal back in' – both imaginatively and practically (ibid: 366).

McGregor's analysis alerts us that human-human encounters need to receive very careful, historically situated and specific attention if we are to analyse human-animal relationships in postcolonial contexts. As the following *Chapter 3* will discuss, intrahuman encounters with malaria have been closely linked to imperialism and colonialism, as well as encouraged racist tropes and practices. There is a distinct history of associating the tropics with disease,

lassitude, laziness, overly beneficent or destructive nature – in short a whole "moral climatology" (Livingstone, 2002). Thus, there is a real challenge to speaking about the prevalence of certain sorts of diseases in the tropics that needs to receive careful attention. If not, we risk overlooking marginalized and silenced groups of people, misinterpreting historically and culturally situated understandings, as well as overhearing the subtleties of local responses.

An analysis by Gayatri Chakravorty Spivak offers a powerful example in this respect. In her article on *responsibility* (1994), Spivak discusses a conference on flooding in Bangladesh, which was organised by the European Parliament. She argues that both the European Green Party (organisers of the conference) with its emphasis on the protection of nature, and the World Bank, who were working in a developmentalist mindset, both acted on the basis of binary logics, which neglect and misunderstand the Bangladeshi relationship of land, its people and the floods "by something confusedly called European common sense" (ibid: 63).

This is exemplified in the wrong translation of the Bengali words "barsha" and "bonna", where "barsha" is translated as "normal beneficial floods of the rainy season", while "harmful floods of abnormal depth and timing" are "bonna". According to Spivak one cannot press those two terms into opposing meanings, rather:

> In the context of this water-borne land still in the making in the rough theatre of mountain and wind, the strict differentiation between rain and flood fixed in the (Indo)"European" mind-set is persistently deconstructed, the one implying the other. When the balance is disturbed, so that the opposition begins to come clear again, the signification is: disaster' (ibid: 64)

To Spivak the wrong, binary translation of these concepts illustrates the silencing effects of Euro-US domination over its Others. To venture a response, to take over responsibility in this case resulted in misunderstanding; its effect is silencing. Response and response-ability are thus not easy tasks; they require making oneself familiar, carefully familiar and this requires patience. If not, as Spivak shows so eloquently, response can make things worse.

While this powerfully reminds us of the pitfalls and challenges that a triadic analysis of human-human-nonhuman processes poses, Spivak's work also points us towards a connection point of postcolonial studies with relational, other-than-human geographies: both excavate and refigure uncaring binary ways of thinking and their harms. In order to work towards more cosmopolitan ways of living together – both for human-nonhuman encounters and for encounters of (former) colonialisers with (former) colonialised people, we might need to be sensitive to asymmetries. As I have argued in *Section 2.3* this might require looking at things, humans and non-humans symmetrically in order to excavate asymmetries and injustices. *Chapter 7* will experiment with this idea most explicitly; in the chapter I argue that in order to make marginalised realities of bednets visible again, it is necessary to juxtapose different aspects and effects of bednet policies.

Developing such a postcolonial sensibility in our writing has been called for more broadly within geography; Jenny Robinson (2003) for instance suggests the need for "postcolonizing the discipline" and offers a "range of practical tactics and resources" (ibid: 274). According to Cheryl McEwan, the challenge for postcolonial geographies is to mix conceptual elaboration with empirical case studies, to deal "simultaneously with the material and immaterial, the cultural and the political" (McEwan, 2003: 343). In a recent article Tariq Jazeil and Colin McFarlane encourage us to question the modes of social scientific

knowledge production, and propose that "responsible learning is, for us, the name we give to a postcolonial momentum, that demands particular questions of what is at stake in international research production including questions as fundamental as why we are producing research, for which publics, in which ways?" (Jazeel and McFarlane, 2010:122). Mitchell concludes his analysis on mosquitoes and malaria on a similar note:

> Social science, by relating particular events to a universal reason and by treating human agency as given, mimics this form of power. The normal methods of analysis end up reproducing this kind of power, taken in by the effects it generates. In fact, social science helps to format a world resolved into this binary order, and thus to constitute and solidify the experience of agency and expertise. (...) To put in question these distinctions, and the assumptions about agency and history that they make possible, does not mean introducing a limitless number of actors and networks, all of which are somehow of equal significance and power. Rather, it means making this issue of power and agency a question, instead of an answer known in advance (ibid: 52-53)

To recapitulate, what I am arguing in this section is that bringing postcolonial concerns to other-than-human geographies poses challenges; while, at the same time, opens up a space for questions. Particularly, questions such as who gets granted speech and agency in malaria control interventions; or, who gets to decide over the strategy and design of interventions? How do mosquitoes and parasites interfere with those politics? And how are tools of malaria control, such as bednets, entangled in politics? These questions will be explored explicitly in *Chapter 7* and *Chapter 8*. But, by discussing the work of Timothy Mitchell and Hugh Raffles, I also argued that writing other-than-human accounts of malaria

control requires thinking carefully about research methods. This will be the subject of the following section.

2.4 Postcolonial ethnography and other-than-humans

As has been illustrated in the *Introduction* already, my main research method consisted of ethnographic observations and accompanying qualitative interviews. Everyday aspects of my work in Ghana have been subject of *Chapter 1.5*, in this section I will discuss methodological considerations that are of importance to the empirical chapters and the overall argument of the thesis. I have argued over the last sections that practising conviviality and response-ability requires us to expose ourselves to learn, un-learn and re-learn our relationships with the world. Such an understanding of the social as complex, surprising and more-than-human does not only change the poetics and politics of writing, but has implications for the boundaries between sciences and humanities, and on what counts and should be included in social analysis. Thus, in many ways methodological points have been made by the discussion of theories in the sections above. The following section will bring together the issues raised in this chapter so far and spell out their methodological implications. The aim here is to find a way of, at once, doing an ethnography of 'human others' and of 'other-than-human' entities.

In the 1960-70s anthropology experienced a 'post-colonial crisis' that had profound implications for the discipline's self-understanding and methods. In this respect Talal Asad's work *Anthropology and the Colonial Encounter* (1973) can arguably be called one of the most influential analyses at the time. Asad argues that anthropology as a discipline and its research practice is deeply rooted in colonial power relations, which enabled Western scholars to conduct ethnographic and cultural research in colonial countries. Anthropology was identified as not only having been a tool of empire but also as having benefited

intrinsically from imperial relations. Asad's and associated strong critiques have prompted a significant change in the understanding and practice of ethnography. The authority of research was destabilised, which increased reflexivity and modesty in its claims, and led to a rethinking of *The Poetics and Politics of Ethnography* (Clifford and Marcus, 1986). Furthermore, George Marcus' influential call for "multi-sited ethnography" (1988), aimed at decentering anthropology's claims of knowledge about local cultures, can be seen as a result of these debates. Marcus proposes a research strategy that allows for connections and interplays between the local and the global, an ethnography which "moves out from the single sites and local situations of conventional ethnographic research designs to examine the circulation of cultural meanings, objects, and identities in diffuse time-space" (ibid: 79).

> Multi-sited research is designed around chains, paths, threads, conjunctions, or juxtapositions of locations in which the ethnographer establishes some form of literal, physical presence, with an explicit, posited logic of association or connection among sites that in fact defines the argument of the ethnography. (ibid: 90)

In a similar vein, John Law's focus in his ethnography *Organizing Modernity* lies on the detection of "ordering patterns" in societies (1992). His starting point is the observation that life is always changing and on the move, and therefore, established orders are always to be considered as temporal: "So if they [the data] stand still for a moment then it is because they have achieved some kind of pragmatic, temporary stability, an ordering pattern, encountered resistances, which momentarily domesticate both the material and its audiences" (Law, 1992: 51). This point is not only interesting with regards to how we think about social order, but has important implications for methodology in general. It points to the limits of research

and calls for a reflexive and always preliminary understanding of one's own research findings. Law terms this "modest sociology":

> [Modest sociologists] tell that they [descriptions] are incomplete, not because they haven't quite finished the business of sorting out the order of things, but rather because they know that it is *necessarily* that way: they will always be *incomplete*. Such sociologies are relatively modest, relatively aware of the context of their own production, and the claims they make tend to be relatively limited in scope (Law, 1992: 9).

In more recent work Law (2004) develops this argument further arguing that methods co-produce its research object: "The argument is no longer that methods *discover* and depict realities. Instead, it is that they participate in the *enactment* of those realities" (2004: 45). Methods (and herewith the researcher) become explicitly active:

> Method is not, I have argued, a more or less successful set of procedures for reporting on a given reality. Rather it is performative. It helps to produce realities. It does not do so freely and at whim. There is a hinterland of realities, of manifest absences and Othernesses, resonances and patterns of one kind or another, already being enacted, and it cannot ignore these. Enactments and the realities that they produce do not automatically stay in place. Instead they are made, and remade. This means that they can, at least in principle, be remade in other ways. (ibid: 143)

Such an understanding of the social as complex and performative does not only change research methods and the poetics of writing, but has implications for the boundaries

between sciences and humanities, and on what counts and should be included in social analysis. If we are to follow Mitchell and "make issues of power and agency a question" (Mitchell, 2002: 53), this encourages us to expose ourselves to learn, unlearn and relearn. Analytically we are then interested in how complexities and politics emerge, are made and remade through practices – in short, it means to adopt a "praxiographic approach" to research (Mol, 2002).

If research methods as well as (our) practices create realities, epistemology and ontology are understood as intertwined and reality becomes "more than one and less than many" (Mol and Law, 2002: 11). And herewith ontological questions become political, as Annemarie Mol (1999) has put it: "The word 'ontological politics' suggests a link between the real, the conditions of possibility we live with, and the political" (ibid: 86). An analysis sensitive to ontological politics pays attention to how different actors interact, and together constitute the object of inquiry – it pays attention to interferences between practices, and to how social science methods can create interferences themselves. At this point, Donna Haraway is helpful again:

> So, for me, the most interesting optical metaphor is not reflection and its variants in doctrines of representation. Critical theory is not finally about reflexivity, except as a means to defuse the bombs of the established disorder and its self-invisible subjects and categories. My favourite optical metaphor is diffraction – the noninnocent, complexly erotic practice of making a difference in the world, rather than displacing the same elsewhere (Haraway, 1994: 63)

Diffraction does not produce "the same" displaced, as reflection and refraction do. Diffraction is a mapping of interference, not of replication, reflection, or

> reproduction. A diffraction pattern does not map where differences appear, but rather maps where the effects of difference appear. (Haraway, 1992: 301)

To Haraway, thus, diffractions can occur when interference patterns are mapped out. Mapping out interferences can open up spaces with the potential to diffract the current "established disorder", or to remain in the optical metaphor: through interferences the trajectory of light waves gets interrupted and channelled into different directions. Diffraction is the aim for Haraway, and a mapping of "worldy interference patterns" (ibid: 60) is, therefore, a means to diffract[26]. In practice, however, interference often makes itself felt through confusion, contradictions or a feeling of unease. For instance, in *Chapter 7* I will discuss bednets and the various politics enacted through this simple and beautiful item of malaria control. During my stay in Ghana, the more I learned about bednets, the more ambiguous they became. Not only did many Ghanaians, for very good reasons, actually not like and/or use my favourite malaria control tool, but I also learned that the broad-based introduction of insecticide-treated bednets had unexpected and negative 'side'-effects. They, for instance, marginalized an earlier established, local bednet sewing industry. Local economical concerns interfered with the implementation of a public health tool in unexpected ways. This is an inconvenient realisation that complicates things and makes bednets a much more ambivalent malaria control tool. It is then easy to ignore such an irritation. However, as Helen Verran beautifully points out:

> As a storyteller (a theorist) I treasure these moments, I do not want to explain them away. They are the first clue in my struggle to do useful critique. It is easy to ignore and pass by these moments – part of the problem is their fleeting subtlety-

---

[26] Diffraction, interruption and reinvention (1992) go together and the notions have to been seen in connection to Haraway's project of "refiguration" (inter alia 1991, 1992).

> yet it is possible to become acutely sensitized to them. Interruptions, small and large are what we, as theorists, must learn to value and use. (Verran, 2001: 5)

In this context interference and diffraction have proven to be useful tools for me, in order to productively address such contradications and irritations that my fieldwork triggered. The concept of interference has recently been taken up by a range of scholars (e.g. Mol, 2002; Pols, 2003; Moser, 2003, 2007; Hinchliffe and Bingham, 2007); mainly inspired by Annemarie Mol's work *the body multiple* (2002), where she starts to trace interferences between different versions of atherosclerosis:

> There are, even so, crucial *interferences* between one enactment and the other. It is during an operation that atherosclerosis is materially enacted as a stenotic obstruction in an artery, while a conversation in the consulting room is necessary to turn pain nagging a person into a medically relevant fact. Interferences deserve a lot of further study (ibid: 143-144)

In their study about Asian Bird Flu in Egypt Hinchliffe and Bingham (2007) have systematically traced different modes of interferences, and explicate nicely why attention to forms of connection between different practices is important. They suggest analysing interference helps determining

> (...) whether we might find in these practices any hints that there are other ways of collectively living with disease than imagining that we are perpetually in conflict with it, ways that recognise rather than repress the fragile stabilities involved. (Hinchliffe and Bingham, 2007: 20)

Moser (2007) thinks similarly in her study on Alzheimer's disease. She analyses several disease practices, looks at their relations and points to processes through which dominant biomedical versions make other versions "absent and invisible, excluded and disarticulated. And this works to unmake them. It makes them less real" (ibid: 17). It is important however, that while the dominance of the biomedical enactment is important to her analysis, Moser does not replicate this dominance in her paper. She grants other versions of Alzheimer's therapy equal space and carefully excavates how those perform politics of nature too. In her analysis of an international conference on non-biomedical therapies of Alzheimer's she writes:

> What the Enable-conference showed, was precisely that in order for these other(ed) engagements with Alzheimer's to become present as alternative interventions, a new space had to be made, and one that excluded the pharmaceutical and biomedical enactments that excluded them as alternatives in the first instance. There are limits to what can be made present at the same time in politics (ibid: 25)

Thus, exclusion, inclusion, Othering and struggles over space have to have a place in the analysis of interference as well as mutual support, contradictions and paradoxes of different versions. But through granting other engagements with Alzheimer's as much space in her paper as biomedical versions Moser does something else too. Her paper is not only about forms of interference, but also about interfering. By writing other enactments into the analysis, they get space (again), the Othering through biomedical versions that she has described, is to a certain extent undone in her paper. It gives 'other' than dominant enactments space. Thereby it makes the other versions bigger, they are not marginalized anymore but become part of the discourse, and visible as an alternative. Herewith, the

paper becomes active, it diffracts, "contributes to opening up the politics of nature" (Moser, 2007: 25).

In malaria control and treatment, the politics of nature and interferences between different treatment options can take on particular urgency. For instance, in children with severe malaria the timeliness of treatment is important. A malaria induced coma is reversible in principle, but a day or even hours of treatment delay can increase the parasite load in the blood to a degree that becomes quickly life threatening. Thus, clashes between "traditional" understandings of disease and "modern" scientific malaria is a highly contested issue. Public health campaigns urge mothers to bring their feverish children to the clinic immediately, however, for various reasons, traditional medicine remains the first point of call for many in sub-Saharan Africa. In an effort to raise awareness and increase attendance of biomedical clinics state public health campaigns often, "translate" traditional maladies that have similar symptoms to malaria as "malaria". The politics of these translation and treatment practices is subject of Stacey Langwick's article on malaria in Tanzania (2007). She examines the South Tanzanian malady *degedee*, its symptoms, causations and treatments, and juxtaposes those with the symptoms, causations and treatments of malaria, arguing that the two cannot be reduced to one biomedical disease called malaria, but that the two maladies have complex and partial connections. Furthermore, differences and similarities between the two maladies are strategically mobilised:

> The connections and separations that link and define *degedege* and malaria are forged within the context of an impoverished national health care structure, skewed international economics, changing environmental conditions, particular disease ecologies, long histories of expertise in "seeing" disembodied actors, and elaborate knowledge of plant, animal, and mineral substances. These economic,

> ecological, political, and historical factors position public health nurses and healers differently, and consequently, evoke different articulations of *degedege* and malaria from them. (ibid: 111)

Langwick argues that by paying attention to those different articulations and their practices of diagnosing and treating *degedee* and malaria it becomes clear that the relationships between *degedee* and malaria are complex and political. Furthermore, to her, the different practices do not exist next to each other in a plural health system, but they overlap, clash and interfere with each other. Langwick's analysis shows that attention to practices and ontologies of disease and its treatment is embedded and intertwined with political decisions, it is indeed an issue of ontological politics:

> In these junctures, complicated, interdependent therapeutic ecologies rather than the discrete differentiations of pluralist systems begin to be visible. The coordination of doctors' assessments of symptoms, tests for malaria parasites, and evaluations of anemia and healers' assertions about mischievous *mashetani*, medicinal baths, and herbal concoctions enact the subjects and objects of this southern Tanzanian ecology. Partial, strategic relationships compose these hybrid bodies and disease entities. Attention to such situated connections not only contextualizes absolutist claims but also opens up a space to imagine less hierarchical, possibly more democratic translations. (ibid: 111-2)

Based on this, the following chapters (3-7) set out to explore the heterogeneous, contingent and sometimes contradictory practices of malaria politics in Ghana. The different ways to conceptualise malaria are, thus, not only seen as different strategies to fight against disease, but also as different ways of enacting certain versions of malaria, and – more

broadly – science, society and environment interactions. In this spirit, I will pay particular attention to the role that other-than-human actors play in the making of malaria, how they get portrayed through human actors, how other-than-humans express themselves, and how this gets acknowledged, enacted or rejected through malaria control policies and practices. In the following empirical chapters it will be my aim to elucidate the ontological politics of malaria control in Ghana further, by asking: Which realities are created through different ways of enacting malaria control? How is the ecology of mosquitoes and political economy of the intervention itself related to democratic decision making on malaria (*Chapter 5 and 7*)? How can we locate and define malaria through its practices – biomedical and otherwise (*Chapter 6*)? Firstly, however, the next two chapters contextualise malaria control in Ghana by offering an account of the history of malaria control (*Chapter 3*) and the current international policy constellations (*Chapter 4*). *Chapter 3* explores the history of malaria control, in particular the first worldwide malaria eradication campaign in 1950-60s, and argues that malaria's history suggests an approach to malaria control, which is not only ecologically nuanced but integrates socio-political concerns at its heart. *Chapter 4* then details how malaria control strategies look like today – in its worldwide constellations, as well as more concretely in Ghana. The aim of those two chapters is to prepare the ground for understanding malaria control practices in Ghana. They contextualise and nuance the focus of the analysis by adding historical and political texture to the –conceptual, ethical and methodological– research lens that has been evoked and put forward in this chapter.

Chapter 3:

a history of malaria

Sankofa[27]

San: return, *ko*:go, *fa*: take

Mythic bird that flies forward while looking backward with the golden egg of the future in its mouth. (Agbo, 2006)

This chapter discusses the history of malaria; in particular it will focus on and connect two aspects of malaria's history. Firstly, in *Section 3.1* I will briefly recount early, environmentally deterministic assumptions about malaria and situate those in the experience of colonial exploration. This will provide the background for *Section 3.2*, which explores the first malaria eradication campaign, evaluates its outcomes and scrutinises the role of ecological as well as societal dynamics in malaria control campaigns. The chapter argues that malaria control requires locally specific, ecologically subtle and careful approaches, and shows how the

---

[27] The following substantial and empirical chapters are all preceded by an Adinkra symbol and its connected saying. Adinkra symbols originated from the Akan people, who traditionally occupy the forest areas of middle Ghana, where most of my research took place. The symbols form one part of a story-tellings, myths, local histories and are link to cultural concepts or aphorisms. Adinkra symbols are used on fabric, walls, in pottery, woodcarvings and logos. More information of Adinkra symbols can be found at http://www.adinkra.org, or in Adolph Agbo's book (2006). These two sources are also from where I took the chosen symbols and its connected sayings. The chosen symbols connect more or less loosely to the argument of the chapters, and are generally there to evoke an initial idea about the theme of the chapter, and to create an atmosphere for the following analysis. The symbols will, thus, not be analysed as such, nor are they meant to convey a stringent message or contribute to the argument substantially.

success or failure of early malaria control has depended on a complex interplay between societal and ecological processes.

The chapter is entitled "a history of malaria" in lower case in order to highlight that the chapter does not attempt to provide an overview or a comprehensive history of the spread and understanding of malaria as a disease. In the following, I focus on particular aspects of malaria's history and offer a re-reading of this history with regards to environment and society relations. This has made it necessary for me to take case studies from various countries (such as USA, Italy, Argentina and Nigeria), and relate those to overall accounts of the history of malaria control, in particular the first global malaria eradication campaign (1950/60s). My aim is to excavate dominant logics of malaria control and prepare the ground for my analysis of malaria control in Ghana today, which will unfold in *Chapters 5-7*. Or, to say it with the words of the Ghanaian proverb quoted above, in order to fly forward with the golden egg of the future in our mouths, we will in the following chapter be looking back for lessons of the past. But before the first eradication campaign and the country case studies are discussed in more depth, we will briefly explore some origin stories of malaria.

3.1 In the beginning was the parasite

> Malaria, described by Hippocrates in the fourth century B.C., is almost certainly one of the most ancient diseases of man. Indeed, it is reasonable to suppose that it is older than we, that our primate ancestors were recognisably malarious before they were recognisably human, that the parasite, which causes the fever and the mosquito, which transfers it from one person to another have accompanied us throughout the Darwinian descent. (Harrison, 1978: 1)

Malaria has been killing humans in large numbers for millennia – well before cases were compiled in global health reports. Indian Vedic texts called malaria *The King of Diseases*, a most dreaded affliction conjured up by Shiva's anger. Malaria's symptoms were outlined in the writings of Hippocrates in the fourth century B.C., and genetic tests have linked malaria to the death of King Tutankhamun. But this is still recent history: thousands of years earlier, the Chinese treated fevers with the *qīnghāo* plant, whose active ingredient, artemisinin, is today the WHO gold standard of treatment. Paul Russell, a malariologist, known for his role in the international health division of the Rockefeller Foundation, locates the origins of malaria in prehistory as the outcome of a primordial interspecies encounter:

> Accordingly, we believe that when men appeared, mosquitoes were already an ancient form of life, with needles sharpened and adapted to the procurement of vertebrate blood. Very likely too, the mosquito had already formed its close partnership with the protozoan that is the cause of malaria. In what vertebrate the plasmodia first existed as parasites we don't know, but it seems likely that they were not long, as time is measured, in adapting their metabolism to the chemistry of man's cells and fluids. One assumes (...) that disease is as old as life. (Russell, 1955: 2)

Thus, mosquitoes, parasites and the interaction that is today called *malaria* have existed before humans. In early accounts the disease was mostly not perceived as distinct, but understood as one variation of a diverse range of fever diseases. Fevers have long been related to swamps and other environments close to water pools. For instance, Hippocrates noted in his texts that those who drank the stagnant marsh water "have always large, stiff spleens and hard, thin, hot stomachs, while their shoulders, collar bones and faces are emaciated; the fact is that their flesh dissolves to feed the spleen" (Hippocrates, cited by

McNeill, 1976:102). And it was the atmospheric hypothesis that led to the name *malaria* – the Medieval Italian term 'mala aria' means 'bad air', and signals that until the late 19th century malaria fever was believed to emanate from the unhealthy air in swamps. The etiological significance of air quality was overturned when, in the late 19th century, a French army physician in Algeria, Charles Laveran, observed *Plasmodium* parasites in one patient's blood-slides and subsequently, Ronald Ross a British Garrison Surgeon working in India, associated the life-cycle of the avian *Plasmodium* parasite with the *Anopheles* mosquito. Nevertheless, malaria remains defined by its physical and socio-economic geography.

Colonial understandings of the tropics were also deeply influenced by the experience of malaria (and other diseases). In many colonial accounts the tropics are characterised as bountiful, and, at the same time, barren and nasty (Blaut, 1993; Livingstone, 2002). On one hand European conquerors struggled with fever and other illnesses, which made exploration and colonisation difficult; on the other hand they were driven by commercial interests (as for instance the prospect of inter alia gold mining[28] and the hope for a prosperous agriculture), evoked by the lush landscapes and rich biodiversity of the African continent. This explains interest and persistence of Europeans in 'exploration missions' and the establishment of permanent colonies. However, both tropes –the bountiful and the nasty– "are used toward the same end: to show that tropical regions have inferior potential in history" (Blaut: 77). Conveniently this was twisted into a justification for colonialism – popularly known as "the white man's burden". And malaria, like several other infectious diseases, played an important role in the formation of this deterministic view of landscapes and their populations: "the history of malaria and its close association with medical topography were no less important in informing British and Indian attitudes towards environment, health and race, and in establishing the authority of medicine in representations of the self and other"

---

[28] As evident in the name 'Gold Coast' for the part of Western African coast line that is now Ghana.

(Arnold, 2000: 81). Thus, malaria and other diseases served to establish a contrast between 'natives' and 'Europeans'. This was aided by the observation that this environmental nastiness of the tropics did not affect everyone equally. Seemingly, local Africans were resistant against the devastating effects of the fevers:

> The three ships of the expedition entered the Niger River in August of 1841 during high waters of the rainy season, the proper time to travel inland. All hands were in good health (...) Within three weeks after entering the river course, many of the expedition members became ill with fever. On September 17, five weeks after traversing inland, 63 out of the 145 whites were sick, mostly with fevers, and 7 had died. (...) The vessels could hardly function (...) A review of the health status of the expedition showed that 130 of the 145 whites had been ill and that 11 out of the 25 blacks from Europe had had fever. In a period of about two months 40 whites had died, and none of the blacks had suffered fatal illness. The indigenous Africans employed on the expedition had escaped being sick entirely.
>
> (Carlson, 1984: 15-16)

It is through stories like this that West Africa has gained its reputation of being the "white man's grave" (Carlson, 1984; McNeill, 1976; Watts, 1997; Haynes, 2003). Haynes analyses both expressions "the white man's grave" and "the white man's burden" as "paralleled Victorian tropes that justified the British imperial project in the name of unique racial responsibility" (Haynes, 2003: 177). However, the vulnerability of the white colonizers to mosquito-transmitted diseases did not go unnoticed by African populations either:

> Incidentally, some Africans believe that malaria, in areas such as those on the West Coast, has been an ally, striking down and thus greatly limiting the

acquisitive powers of the non-immune white 'invader'. In the words of S.D. Onabarimo, a Lecturer in University College, Ibadan, Nigeria, 'Let us give thanks therefore to that little insect, the mosquito, which has saved the land of our fathers for us. We cannot sing its praises too often. The least we can do is to engrave its picture on our National Flag'. (Russell, 1955: 244)

For the colonialists, these differences in vulnerability to malaria opened the door to colonial segregation policies, where African children were hypothesised to be a disease reservoir for parasites (Ross, 1910). As a consequence, white populations were housed in areas fenced off from African housing, a geography one can still trace not only through architecture and housing stock, but also in today's environment: The affluent areas of Accra are often framed by alleys of Neem trees, planted in order to fight of mosquitoes[29]. Such practices of geographical distancing demonstrate a mutual influence between the wish and ability to tame the environment and racial discourses which are rooted in discourses of the 'natural' superiority of one population over another. Biomedical knowledge also played an important role in the wider construction of 'the African' that -as Meghan Vaughan argues- in many ways still pertains today:

> In the late twentieth century, as in the late nineteenth, the European imagination is easily captured by the image of the white doctor in a dark Africa. [...] The white doctor stands for confronting both the 'nature' and the 'culture' of the dark continent, the boundaries between which are disturbingly ill-defined. [...] The wild Africa is still there, to be glimpsed through the window as something both beautiful and deadly, whilst inside the hospital the encounter with the other Africa goes on in struggles with disease and death. But, we are reminded, there is also

[29] Personal conversation with Regina Penrose, Accra August 2008.

hope – not so much in the birth of a black baby but in the miracle of its white palms. The western medical discourse on Africa, as this example indicates, is not always marked by its subtlety. In the post-Enlightment European mind Africa, it seems, has been created as a unique space, as a repository of death, disease, degeneration, inscribed through a set of recurring and simple dualisms – black and white, good and evil, light and dark (Vaughan, 1991: 1-2)

Thus, and as David N. Livingstone also argues in *Race, Space and Moral Climatology* (2002): "disease ecology and moral cartography were much closer than distant cousins" (ibid: 173), through carefully tracing discourses on race, climate and disease Livingstone "redraw(s) attention to the ease with which climate was read through moralistic lenses and translated into the language of diagnostic medicine" (ibid: 169). In this sense we could say that colonial thought was encouraged – or even compelled – by experiences with tropical disease to take certain sorts of non-human agency seriously. But, together with Livingstone, I would like to suggest that observing such differences need not to be translated into a moral hierarchy, in which those who are closer to nature are disparaged or devalued. While accounts such as the "white man's grave" contribute something important to the understanding of the differential force of nonhuman agency (such as the lack of resistance to tropical diseases in white bodies, or local immunity in Africans to malaria), it is at the same time important to guard against the extrapolation of this into a moral climatology of racial hierarchy and racist practices (Livingstone, 2002). This also shows that taking account of nonhuman agency, in itself, is not a politically progressive move.

To recapitulate, early understandings of malaria as a disease have always been intermingled not only with colonial governance, but also with broader racial and societal tropes, and this is the background against which malaria control techniques have been

conceived and exercised. In the following section I will zoom into concrete practices of malaria control and their paradigms, in order to excavate the dominant logics with which malaria control has been conducted historically. I focus on the first malaria eradication campaign of the 1940-60s and discuss case studies from the USA, Italy, Argentina and Nigeria. As we will see those cases suggest that intertwined environmental, medical, social, political factors are crucial to malaria's 'retreat' or 'victory'.

3.2 The rise of the eradication agenda

3.2.1 The Global Malaria Eradication Programme (GMEP) 1955-1969

Malaria control interventions have existed as long as the disease. It was an integral part of colonial practices. However, as we have seen in the previous section, such practices were often informed by an ill-understanding of the transmission of malaria and highly racialised. The discovery of the plasmodium parasite by Alphonso Laveran as well as the malaria transmission mechanism by Ronald Ross for avian malaria –and shortly after by Giovanni Grassi for human malaria– in the late 19th century let a biomedical definition of the disease emerge, and lay the foundations for technological innovations in malaria control. Already the 1920-30s saw advances in focused malaria control and led to larviciding projects. Larviciding, screening and the creation of ditches were for instance crucial elements of the malaria (and yellow fever) control strategy while building the Panama Canal (Gorgas, 1915; Spielman and D'Antonio, 2001: 124ff). Meanwhile in Argentina, Carlos Alvarado developed "foci patrols" – a highly local, flexible and experiential larviciding technique, which was based on carefully derived knowledge of malaria and mosquito behaviour in a specific environment (Carter, 2007). Shortly later, Alvarado's friend Fred Soper would make "foci patrols" famous through the elimination of *Anopheles gambiae* from Brazil, where highly virulent falciparum malaria epidemics had occurred around the port of Natal in the 1930s, by

1938 the *Anopheles* had spread over an area of 54,000 square kilometres. Despite this being a remarkable achievement, it can probably be said that Soper had a bit of an easier battle than malaria experts have in many hotspots today, because *Anopheles gambiae* were not native to Brazil, but had arrived as stowaways on warships from West Africa (Killeen et al, 2002; Killeen, 2003).

Most technological innovations were, however, developed during WW2, most notably the malaria drug *chloroquine* and the insecticide *DDT*[30]. With the availability of DDT as a cheap and efficient weapon against the malaria transmitting anopheles mosquito, the possibility of malaria eradication arose. As the influential malariologist Paul Russell commented in his book *Man's Mastery of Malaria* (1955): "This is the DDT era of malariology. For the first time it is economically feasible for nations, however underdeveloped and whatever the climate, to banish malaria completely from their borders" (ibid: 160).

After an initial success of DDT in Italy with the control of typhus in Naples, and later malaria at the end of WWII (Snowden, 2006; more on this below), the WHO[31] officially endorsed a *Global Malaria Eradication Program* (GMEP) in 1955. However, the decision to embark on a worldwide malaria eradication project was not only motivated by the seeming feasibility, but also based on the knowledge within the scientific community that the occurrence of resistance against DDT would only be a question of time. Indeed, while before 1945 only a dozen species were known to be resistant to pre-DDT insecticides, by 1960 already 139 species were reported to be resistant against DDT (Carson, 1965: 234). Thus, the temporality of eradication was put to use against the tempo of mosquito evolution:

---

30 The link between technological innovations in malaria control and wars is striking: DDT and chloroquine are a product of WWII, Lariam and Artemisinin were developed/discovered during the Vietnam War, and the US Walter Reed Army Institute conducted the very first trials of the now most advanced malaria vaccine candidate RTS,S.

31 In order to appreciate the importance the GMEP had for WHO at the time, it is important to remember that the WHO got founded in 1948 and hence was very much a post-WWII institution, with the GMEP as one of its first big projects.

Eradication had to be executed before the central weapon against malaria was no longer viable. The director general (of WHO) concluded: "There is ... no other logical choice: malaria eradication is clearly indicated, presents a unique opportunity and should be implemented as rapidly as possible. Time is of essence". (Packard, 2007: 155)[32]

And consequently, the programme relied mainly on one tool for its success – insecticide spraying with DDT. However, Africa, the continent with most cases of malaria, was never part of this "all out war" on malaria (Litsios, 1996: 73). Litsios in his analysis claims that "so little malaria control had been carried out in Africa before 1935" that it was just not considered feasible to include the continent (ibid: 106). Eradication was further dismissed because of worries about the holoendemic status of malaria in the vast majority of sub-Saharan Africa. Experts feared that an only partially successful eradication campaign could reduce the acquired partial immunity of Africans, and this would have yielded the danger of an even greater malaria mortality than before the campaign. Or, as historians of malaria Mary Dobson, Maureen Malowany and Bob Snow analyse this decision:

> If Africa was included in the Kampala recommendations, how was it virtually excluded from the massive global programme which followed? We propose (...) the tense, little understood relationship between endemicity and immunity that presented sub-Saharan Africa as too difficult to manage within the eradication framework provided the opportunity for the World Health Organization to heed the private warnings of some Kampala Conference participants: 'Don't rush at Africa.

---

[32] As Packard also nicely points out the GMEP was very much consistent with the zeitgeist of the era: The time after the Second World War was dominated by a "know how show how" mentality (ibid: 156), which most prominently was embedded in the development paradigm developed at Bretton Woods, 1944.

> Take it slow and easy.' 'Monotony is the essence of Africa'. (Dobson et al, 2000: 160)

The decision to exclude Africa meant that the campaign was in fact never truly global as its name claimed. It nevertheless left the GMEP with many front-lines in the fight against malaria. International donors put fierce pressure on malarious countries to join the effort, however "unfortunately, many countries were not prepared to launch an eradication program, and the precise strategies laid out by WHO were applied imperfectly at best" (Packard, 2007: 159). This managerial unpreparedness rubbed up against the resilience of the disease and adaptability of mosquitoes, leading to an only mixed outcome of the GMEP. By 1970 only 18 countries had achieved eradication, which equals 39% of the targeted countries (Packard, 2007: 159). More countries eradicated malaria later, plus general malaria morbidity and mortality was reduced greatly through the campaign. However, in many cases these results did not prove to be sustainable. This quick resurgence is to be attributed to several factors, but crucial here were political constellations. Sri Lanka's tragic example illustrates this point well: in 1963 malaria was nearly eradicated from the island with only six reported cases per year. As a reaction to socialist tendencies in the Sri Lankan government the USA withdrew funding in the mid 1960s. Malaria cases exploded in the following years, and reached one million cases only some years later in 1968 (Packard, 2007: 171). This case shows how quickly malaria can gain ground again and exemplifies the disastrous consequences donor fatigue can entail.

The countries that achieved lasting eradication can be divided in three categories: They were either economically developed (such as Italy, Netherlands, United States, Australia, Brunei, Singapore, Portugal and Spain), island nations (such as Grenada, Santa Lucia, Trinidad, Cuba, Jamaica, La Réunion, Mauritius, Taiwan) or socialist nations (Bulgaria,

Poland, Romania, Yugoslavia, Hungary, Cuba) (Packard, 2007: 160, quoting Gramicca and Beales, 1988). Additionally, some countries proved to be more difficult than expected: "When the WHO declared an end to the Malaria Eradication Programme in 1969, a third of the countries in Latin America, Asia and the eastern Mediterranean were still in the attack phase. Some of those countries had been spraying for more than 10 years" (ibid: 160). Other important factors determining the success or failure of eradication were, thus, climate and epidemiological conditions. The countries that achieved eradication had mostly sub-tropical climate with unstable, seasonal transmission; high-transmission regions that managed to eradicate malaria were island nations.

But which factors led to the abandonment of the GMEP after only 14 years? Yet again a multiplicity of influences came together – social, biological and political. One was donor fatigue for political reasons (such as towards Sri Lanka or India in 1972) and more broadly waning funding posed problems. The costs were underestimated at the beginning of the campaign, and important donors started to doubt quickly. For instance, UNICEF that had given between $4.1 and $8.8 million annually started to phase out its support in 1964. Secondly, insecticide resistance (mainly against DDT) as well as drug resistance (against chloroquine) played an important role – the malariologists were running out of time with their grand plan, and mosquitoes and parasites were yet again on the fast lane in the long history of human-mosquito-parasite encounters. The reaction of GMEP to occurring resistance was to change the insecticide applied, as well to add larvicides and drugs to its interventions. But this strategy succeeded in little more than in making the approach more expensive (Packard, 2007: 85). Generally, the reliance on a single tool proved to be unsustainable. But, thirdly, eradication debates were also caught up with broader political agendas of the Cold War era:

The Soviet Union in 1966 stated that the global programme was facing a "crisis", as illustrated by the fact that nobody "would care to predict when it would be possible to free the African continent from the disease". Moreover, the Soviet delegate continued, "the methods and principles adopted for malaria eradication had been over-simplified and were too much alike for all countries". Modifications that had been introduced over time neither had made the strategy for eradication "more universal or more effective". He called for the setting up a "commission of leading specialists from 10 to 15 countries" to make a "critical appraisal of the malaria eradication programme". (Litsios, 1996: 93)

The debate that followed ultimately led to the abandonment of GMEP and malaria eradication more broadly. While this is recognized to be one of the biggest failures of post-WWII public health, the abandonment is often attributed to external factors, such as money constraints, political will as well as (today assumed manageable) insecticide resistance. The campaign as such is still regarded as highly successful by many, and particularly the effectiveness of DDT as a weapon is only doubted by few. Thus, the common reading of this era privileges an interpretation of a successful malaria intervention as well as DDT, and marginalises other more complex evaluations. The impact of this narrative cannot only be seen in contemporary discussions about the history of malaria, but more powerfully in a recent policy shift back to a malaria eradication agenda that will be described in *Chapter 4*. In the following two sections I aim to nuance those evaluations of success and failure by discussing the process of malaria eradication in the USA, Italy and Argentina, as well as a popular 1970's spraying experiment conducted in Garki, Nigeria. Those case studies point to lacking evidence for a dominant role of DDT spraying in successful malaria control, and illustrate that sustainable control is characterised by an interplay of social, environmental and medical factors.

3.2.2 DDT as the single weapon? 'Kicking a dying dog'

Falciparum malaria has presumably been introduced to the United States around 1680s via European ships coming from Africa, and from this time onwards the Southern States have suffered from malaria until 1951, when malaria was declared to be eliminated from the USA. Commonly the disappearance of malaria is attributed to insecticide spraying campaigns in the 1940s, mainly with the insecticide DDT. The elimination of malaria and the birth of post-war Public Health in the USA were intimately linked, since malaria control was critical for the building of Public Health institutions in the USA. Most significant in this regard is the development of the *Centre for Disease Control* (CDC) out of the *Malaria Control in War Areas Agency* (MCWA).

However, as the careful historical study by Margaret Humphreys (2000) shows, the number of malaria cases declined before the spraying campaign started: "Paradoxically, the period of steepest drop did not coincide with the period of greatest public spending on malaria, which actually came after the disease's steep decline" (Humphreys, 2002: 140). Humphreys convincingly argues that the decline was primarily caused by geographical shifts in population density. And this is due to political changes: in 1933 US Congress passed an *Agricultural Adjustment Act*, which aimed to boost the agricultural economy through incentivising mechanisation and large-scale farming. As a result poor, small-scale farmers were forced from their rented land and had to move to towns and cities in order to sustain a livelihood. People moved away from the fields and so away from mosquitoes, and it was this distance established between people and mosquitoes that arguably broke the parasite transmission circle (ibid: 108-111). And this socio-geographical shift happened before the spraying campaign started; malaria was on its way out from the Southern states from the mid 1930s onwards.

Malaria experts were aware of the significant drop in numbers, but did not trust this reduction and decided to go ahead with the campaign. The campaign was built on the strength of DDT, in line with international developments at the time and the logic of war prevailing more broadly. Spraying ended in 1951 with the announcement that malaria had been eliminated from the USA. It was a major public health success that is still frequently evoked today when the move back to eradication and mass insecticide-spraying campaigns (today mainly in sub-Saharan Africa) is justified. However, as Humphreys subtle and complex analysis shows (a) the malaria problem in the USA was diminishing before the spraying campaign started, and (b) the decline was not a result of DDT spraying but primarily of changed population patterns. And Margaret Humphreys is not alone in observing this; rather she builds her analysis on the evaluation of prominent malariologists at the time, who witnessed the campaign:

> Retrospective analyses by Andrews, Paul Russell, and Alexander Langmuir, all men at the centre of the malaria wars of the 1940s, were murky on the overall effect of the massive DDT spraying programme. Russell claimed that it probably interrupted a "prolonged condition of light endemicity", while Andrews wondered if it did even that much. Langmuir wrote Andrews, "Even in this country (the United States), it is wholly impossible to judge the extent to which the control of malaria is related to organized insect control". After citing Andrew's own work, he went on, "I certainly concur with your conclusion that the decline in malaria in this country had started well before the DDT period, and the best we can claim in this country is that "we kicked a dying dog". (ibid: 149)

3.2.3 Integrated control, nuanced

Humphreys' analysis of a nearly accidental eradication of malaria in the USA strengthens integrated approaches to malaria control, which are based on entomological, environmental and medical knowledge, and are sensitive to socio-economic and political situations. And Italy's three-phased eradication campaign *bonificia integrale* –initiated under Mussolini's facist regime– could be characterised as such an integrated socio-ecological approach (Carter, 2007). However, such an integrated approach risks being an "all-encompassing mode of control" (Amorosa et al 2005:68) that suggests all processes in a society can be aligned and controlled. A brief discussion of malaria eradication in Italy and Argentina helps us nuance this perspective.

The history of malaria control and its disappearance in Italy resembles the history of the USA, but there are some differences that are worth exploring briefly. In the following I mainly draw on Frank Snowden's historical analysis of *The conquest of malaria in Italy* (2006). Malaria was endemic in most parts of Italy up until the 1940-60s, when a major DDT spraying campaign was conducted. Malaria was officially declared to be eradicated in 1961. However, extensive malaria control efforts had already begun before WWI. Following the discovery of Giovanni Grassi that human malaria was transmitted by mosquitoes,[33] Grassi became the leader of a broad malaria control project in Italy. Malaria was defined as an occupational disease and a "quinine tax" was imposed on employers and landowners to fund malaria control (ibid: 54). Because the public health system was weak the antimalarial campaign established a new network of "rural health stations", whose primary function was the administration of quinine. However, it quickly became obvious that

---

[33] Shortly before Grassi's study of human malaria transmitted by anopheles claviger, Ronald Ross had published his paper on the transmission cycle of avian malaria. According to Desowitz (1991) the competition and animosities between Ross and Grassi were fierce, but Grassi's study came second in the race to prove the transmission cycle of malaria (ibid: 192ff), why the Nobel Prize went to Ross.

> The most important function performed by the health station was to overcome suspicions of the uneducated. (...) Grassi argued that every doctor in the antimalarial campaign rapidly learned "the great truth" that malarial patients would never trust a doctor who referred them to other physicians for every problem except malaria and provided no therapy except quinine. (ibid: 58)

Thus, a network of primary health care facilities developed out of the antimalarial campaign. Furthermore, education was key, the teaching of a "right to health" ethic was an integral part of public health and linked to the development of a "hygienic consciousness" (ibid: 77). Similar to Humphrey's analysis of the USA, in Italy "rapid industrialization and commercialisation of agriculture and mass overseas emigration" (Snowden, 2006: 82/3) also contributed to bringing malaria rates down. However, emigration and the concerted efforts to diagnose and treat malaria came to a halt with the beginning of WWI, and malaria gained ground again.

After WWI and the instalment of the fascist regime under Mussolini, the fight against malaria had high priority yet again. Through drying out a swamp area near Rome –the Pontine Marsh– 'il Duce' set out to create a new province called Littoria (today Latina), and hereby aimed to prove the superiority of fascism as a mode of governing society. The process enabling this was intimately tied up with malaria control and called *bonifica integrale*. In contrast to the earlier strategy, which was mainly focused on quinine, *bonifica integrale* consisted of three stages: First, *bonifica idraulica*, which was mainly the "elimination of malarial swamps through drainage, flood control, the filling of depressions where stagnant water collected, and the rectification of environmental ravages through reforestation" (ibid: 151). The second phase concentrated on the settlement of people and intensive agricultural cultivation, which was meant to dry the land, whilst it was hoped that the introduction of pigs

and cattle would divert mosquitoes. Thirdly, emphasis was put on hygiene, which included building "sturdy and well-screened brick housing" (ibid: 152), and included Grassi's quinine treatment approach.

In the beginning *bonifica* was mainly focused on Littoria. The campaign later got extended all over Italy, but yet again war interrupted the efforts. WWII saw a stagnation of the programme, when farmers and health personnel left the rural areas. Malaria cases were slowly rising again, but not to epidemic level. This changed with Hitler's occupation of (the most part of) Italy after the Italian change of allegiance in 1943.

> It was in this context of impending military crisis and vengeful occupation policy that Germany implemented a violent scheme – a plan of biological warfare carried out in the reclaimed Pontine Marshes. German motives were twofold: to delay final defeat by any means and at any cost, and to exact revenge. In pursuit of these twin ambitions, the Germans carried out the only known example for biological warfare in twentieth-century Europe. (ibid: 187)

And it was indeed malaria that became to be the first biological weapon in the 20th century. From October 1943 to March 1944 the Nazis violated the *Geneva Protocol* and *Treaty of Den Hague* war conventions. The Pontine Marshes were flooded on the pathway to Rome creating an ideal breeding ground for the still inhabitant *Anopheles* mosquitoes. But the plan to stop British and American soldiers occupying Italian territory through contracting malaria completely failed. The allied forces crossed the marshes before the malaria season had started properly, and additionally were taking quinine as well as other protective measures. But the local Italian civilians, weakened by the war, and without functioning health infrastructure, were exposed to one of the greatest upsurges of malaria in modern Italian

history. Cases of malaria in Littoria province rose from 614 in 1939 to 1,217 in 1943, and exploded upwards to 54,929 cases in 1944 (ibid: 197).

The end of WWII and the epidemic in Littoria paved the way for a third malaria campaign, which led to the elimination of malaria in Italy. But as we have seen above, it was a new tool that was to provide the dominant tool of this phase: DDT. Building on DDT's success against lice, the US army launched a spraying campaign that targeted all areas of standing water, mainly via outdoor spraying and preferably executed from the air. The spraying first focused on the epidemic in Littoria, but got quickly extended to cover the whole nation. And the campaign was successful, malaria rates went down quickly. However, as Snowden qualifies:

> In evaluating what took place in Littoria, one needs to avoid the superficial impression that the final victory against malaria was due solely to DDT. It is all too easy to forget that before DDT was sprayed from the air, the CPA launched an emergency program that was based on hard-won lessons in antimalarial campaigning. (ibid: 201)

Instead of a success owed to DDT only, the malaria cases decreased due to a multifaceted approach and remained low because industrial agriculture was starting up again and investments in welfare were made at the same time. And this is true for Sardinia too, which is often mobilised as a pure DDT success story by DDT enthusiasts:

Even in Sardinia, the “American” appearance of a purely technological victory over malaria by the means of a single weapon is deceptive. In the severely impoverished Sardinian economy, for instance, ERLAAS became the largest single employer on the island, hiring at its height some fourteen thousand

peasants as scouts and sprayers. By providing mass employment, ERLAAS substantially reduced the hunger and malnutrition that so many considered the essential substrate of malaria on the island. (...) Equally important, ERLAAS and the Rockefeller Foundation did not act alone on the island in matters related to malaria. As on the mainland, UNRRA intervened in a manner that had significant implications for public health. (...) Clearly, DDT was no longer a single, isolated variable but part of a complex interaction involving humans, the environment, and the economy. (ibid: 207)

Here again the conclusion is that a "complex interaction involving humans, the environment, and the economy" (ibid) was responsible for the disappearance of malaria in Italy. Notable here are especially two things: firstly, education was an integral part of malaria prevention and control from the very beginning of malaria campaigning in the country. And secondly, the use of malaria as a biological weapon through the flooding of marshes, where anopheles mosquitoes were still present. The terrible malaria endemic that was triggered by this crime shows, firstly, how vulnerable the malaria life cycle is to environmental change, and secondly –as Humphrey's case study also demonstrates– emphasises the importance of mosquito density and distance to humans for the malaria transmission cycle.

However, as Eric Carter points out in his study of malaria elimination in Argentina, such integrated approaches to control malaria have bottlenecks too. Integrated control tends to fail if it is not built on a careful and intimate understanding of vector and parasite behaviour. Carter shows how malaria experts in Argentina in the 1930s, who were initially strongly influenced by the Italian model, quickly realised its inadequacy for the Argentinean landscape (Carter, 2008a). After Italy's *bonifica integrale* approach failed to affect Argentinean malaria, the physician Carlos Alvarado derived a new approach for the country,

which was highly innovative building on careful research on the ecology of malaria. Alvarado proved that the Argentinean malaria vector *Anopheles pseudopunctipennis* bred in clear water rather than swamps (like the vectors in Italy). Based on this detection, Alvarado and his team concentrated their efforts at identifying and eliminating local breeding sites. Alvarado termed his approach 'foci patrol' – a highly local, flexible and experiential larviciding technique, which was based on locally derived knowledge of malaria and mosquito behaviour in a specific environment. As Carter has put it nicely:

> One of the major lessons of this study is that 'ecological' or organicist social frameworks may contribute little to malaria control, and perhaps even undermine it, while circumscribed applications of ecological science create the opportunity for progress against the disease (...) Alvarado applied 'ecological' science to specific questions about malaria, mosquitoes, and the environment, and generally resisted making broad claims about the impact that malaria control would have on environment and society. Foci patrol was based on local, flexible, and experiential knowledge. (...) Ecology, holism, and local knowledge do not always line up on the same side, against technology, reductionism, and universal methods. Science in action – indeed, people in action – constantly blur these lines". (Carter, 2007: 649-50)

Alvarado's foci patrol larviciding approach later gained prominence through Fred Soper and the Rockefeller Foundation, who eliminated the *Anopheles gambiae* in Brazil using foci patrol and larviciding (Killeen et al., 2002; Killeen, 2003). As we have seen earlier, Fred Soper later witnessed DDT's killing power in Naples, and both Soper and Alvarado would denounce their careful, local and ecologically sophisticated approaches to become enthusiastic advocates of DDT – Alvarado as Director of GMEP and Soper executing

malaria eradication in Egypt for the Rockefeller Foundation (Carter, 2008b). As the previous sections show, the subtleties of early 20th century malaria control in Europe and the Americas are highly instructive for malaria control strategies more broadly. But this doctoral thesis is concerned with malaria control in Ghana, in sub-Saharan Africa. So, what do these historical analyses imply for prospects of malaria elimination in tropical environments with stable, perennial high-transmission of malaria?

3. 2.4 The Garki Project – spraying in high transmission areas

Sub-Saharan Africa has seen two major scientific projects concerned with insecticide spraying against malaria in the early 20th century. The first was conducted in the Pare-Taveta Mountains in the border regions of Kenya and Tanzania, and was a direct outcome of malariologist Bagster Wilson's unease with the outcomes of a major conference on malaria in Africa in Kampala, Uganda in 1950, which led to the exclusion of Africa from the eradication program. "Bagster Wilson saw Pare-Taveta as the testing ground (...) that the effectiveness of massive control programs was in direct relation to knowledge of the local relationship between immunity, endemicity and health" (Dobson et al, 2000: 163). Unfortunately, Bagster Wilson died before the scheme was concluded and until today there is no concise documentation of the trial's scientific results published.

The second trial of wide-ranging insecticide spraying is the *Garki Project*, which was carried out from 1969-1976 in Garki, Northern Nigeria by an international research team that was mandated by WHO and the Nigerian government (Molineaux and Gramiccia, 1980). The aim of the project was to conduct a comprehensive study to see if a disruption of the malaria transmission cycle is possible in a stable high transmission area in a rural African savanna (more concretely, a climate and vegetation zone in Western Africa called "Sudan

savanna")[34]. The results of Garki were very influential in debates surrounding the end of the malaria eradication program, and often served as justification for a malaria control paradigm in the decades after.

In Garki three different strategies were tested. Village 1 had IRS spraying every 8 weeks in the two major transmission seasons; Village 2 received the same IRS, plus mass drug administration every 10 weeks; whereas Village 3 received IRS, mass drug administration every two weeks, plus a limited amount of larviciding (ibid: 23-25). The study grew out of previous smaller field studies in high-transmission areas of sub-Saharan Africa which drew mixed, if pessimistic conclusions for the prospect of malaria eradication in high transmission areas (ibid: 17). And while the main authors of the study had actually set out to prove that eradication in sub-Saharan Africa is possible (Litsios, 2002), the Garki experiment came to be the study that closed the discussion of malaria eradication in Africa for a considerable while: "The experiments showed that interrupting transmission was not possible even when a full armamentarium of malaria control tools was applied" (Greenwood in Arrow et al., 2004: 208). More concretely, the authors of the study itself reported that "the domiciliary spraying of propoxur alone had a very limited impact on malaria. The vectorial capacity (i.e., the risk of transmission) was reduced by about 90%, but the prevalence of *P. falciparum* was reduced only by about 25% on the average and in the villages with the highest baseline transmission, a new equilibrium had already been reached after 2 years" (Molineaux and Gramiccia, 1980: 290)

This means that while the number of malaria cases and mortality decreased impressively, there was no significant change in the numbers of parasites in the population. Furthermore, as one of my interviewees in Ghana put it: "the Garki experiment eradicated malaria in an

---

[34] In addition to this the Garki project is known for having been the first big field study that included mathematical models of malaria transmission.

area and then watched how it slowly moved in again". The research team considered several reasons for this failure: operational inadequacies, ineffectiveness of insecticide, immigration of infected people and/or vectors, and "the very high baseline level of transmission and the relative exophily of the vector" (ibid). All but the last explanation could be excluded, and the authors conclude:

> The exophilic behaviour is probably genetically determined, at least in part. Hence a significant fraction of the vector populations avoids exposure altogether and has a normal longevity. This has the following consequences: (1) transmission may continue, even if the insecticide is 100% effective at a single exposure; (2) the actual reduction in vectorial capacity (risk of transmission), corresponding to a given reduction in density and average age of a vector population, is smaller than the reduction calculated in the usual way, which implicitly assumes a uniform exposure of the vectors to the insecticide. (...) Even the modest gains due to propoxur may be nullified by the development of mosquito resistance to propoxur after a few years. It may be concluded that in the rural areas of the Sudan savanna of Africa residual spraying is not to be recommended as a malaria control method. (ibid: 291)

This was a very clear and strong recommendation, especially if one considers that Louis Molineaux actually had set out to prove that eradication in holotransmission areas is possible (Litsios, 2002). And indeed as Lines et al. state, the results of the Garki project were "the nail in the coffin" for the WHO-led debate on malaria eradication (Lines et al., 2009: 6). However, as so common with the complex disease that malaria is, the conclusions are not as clear as they first seem:

This famous study was also recorded as a failure because it failed to break transmission despite an intensive effort. Ironically, though, the Garki trial was enormously successful at reducing illness and mortality. If the goal of the study had been defined as "malaria control", rather than malaria elimination, it would have been treated in history as a success, rather than remembered as a failure. This misinterpretation was very costly in public health thinking, because it erroneously led to the unfounded conclusion that malaria control efforts in sub-Saharan Africa "would not work". (Sachs and Chambers, 2009: 313)

In this sense, the Garki experiment has to be interpreted within the context of its time, where the pressing question was "eradication yes or no?". The reduction in malaria cases (through a reduction in vectorial capacity, i.e. transmission was reduced by 90%) is certainly significant and in itself a success. However, this does not change the fact that the cycle of transmission was not interrupted, and that only two years after the end of the intervention a new mosquito equilibrium had been reached, which means the spraying was effectively undone again. The results in Garki certainly serve as a warning for today's IRS projects: Once spraying stops in high transmission areas, mosquitoes will move back in. Furthermore, the high-transmission levels are still present in sub-Saharan Africa, and so a repetition of the Garki experiment today would most certainly not yield different results to the ones in the 1970's:

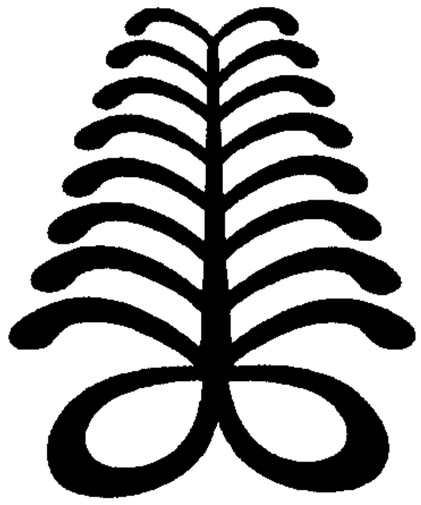
What has changed since then? Our weapons of attack – the insecticides and drugs – are perhaps a little better now, but the difference is probably not great. Probably more important are the environmental and socio-economic changes that may have rendered background transmission levels somewhat lower than before. However, these factors are certainly not sufficient to justify any confidence that a

repeat of the Garki trial would achieve complete success. Moreover, in many parts of Africa, other important factors – notably levels of civil security and infrastructure – are arguably less conducive to a technically complex sustained intensive campaign now than in the 1970s. Thus, until we have convincing new evidence to the contrary, the assumption has to be that in parts of Africa transmission cannot be interrupted with the tools we have. This is certainly the current consensus among malaria scientists. (Lines et al, 2009: 6)

In this chapter I aimed to show that successful malaria control has in the past depended on a complex set of factors: geographical distance between disease vectors and humans, agricultural land use patterns, education about biomedical treatment, distinct vector behaviour and baseline transmission levels all constituted decisive factors that determined success or failure of malaria control in the past. Successful malaria control cannot be pinned down easily. What is clear, however, is that neither a simple technological fix, nor an all-encompassing socio-ecological model offers a comprehensive approach to malaria control. In fact, it can be argued that there is no comprehensive approach to malaria control at all, because it would not suit its object. Malaria's realities are multiple, it is a highly specific and local disease – a vector-parasite-human encounter that is moving and shifting. Successful malaria control needs careful ecological science, knowledge about the ancient practices of mosquito-men adaptation – in short, a specific, locally sensitive and always provisional approach. So, how has the story of malaria control continued after the first *Global Malaria Eradication Campaign* was abandoned, and where do we stand today with regards to global malaria policies and interventions? These themes will be discussed in the following chapter.

Chapter 4:

Malaria prevention and treatment strategies today



AYA

"fern"

The fern is a hardy plant that can grow in difficult places.

4.1 Malaria control interventions – where are we?

Since the global malaria eradication campaign failed in the late 1960s, the paradigm shifted to international malaria *control* focusing on enabling access and delivering malaria care to patients in need. This shift was in accord with developments more broadly in global public health at the time, such as the *Alma Ata Declaration* in 1978, which underlined the importance of "primary health care" for all as an approach to organise global health needs (WHO, 1978).

The end of the eradication campaign, however, also meant a drastic fall in funding for interventions specifically targeted at malaria. Some argue that as a consequence the last decades have been characterised by a resurgence of malaria cases (WHO, 2005: 12). Others argue that resistance against chloroquine has been the most influential factor in the resurgence of the disease (Greenwood et al., 2005). At any rate, in the light of biological resistance, malaria prevention and treatment measures had to change significantly. Instead

of a stable health policy regarding malaria, scientific drug and insecticide development now has to be in movement. Strategies have to take (the threat of) resistance into consideration and new innovative options for treatment and vector control have to be developed continuously. In short, resistance has re-located agency in malaria control – parasites and mosquitoes have been biting back, and humans had to adapt their disease control strategies.

Crucially, not only the biology of malaria changed in recent years, but also political constellations. This chapter will outline the most relevant policy developments in malaria control policies over the last 10 years. *Section 4.1* briefly introduces the new global malaria governance and funding structures. *Section 4.2* shows how a renewed malaria eradication campaign has emerged recently. And lastly *Section 4.3* provides an overview over the four main malaria control tools and its current relevance in Ghana's malaria control strategy: Indoor Residual Spraying (*4.2.1*), Mosquito Nets (*4.4.2*), Antimalarial Drugs (*4.4.3*), Malaria Vaccine Development: RTS,S Vaccine Trials (*4.4.4*).

4. 1 New global health governance constellations

In 1998 the international UN organisations WHO, UNICEF and UNDP founded a common malaria initiative, *Roll Back Malaria* (RBM) in order to coordinate international malaria control activities. RBM is compromised of over 500 partners coming from eight broad constituencies: Malaria-endemic countries, multilateral development partners, OECD donor countries, private sector, non-governmental and community-based organisations, private foundations, research and academic institutions, and lastly *The Global Fund to Fight HIV/AIDS, Tuberculosis and Malaria*. Very much in a philanthro-capitalist spirit RBM is conceived as an international public-private partnership (PPP). Its mission is the

coordination and streamlining of malaria control efforts, the development of a global strategy and importantly, to "mobilize for action and resources" (RBM Webpage, 2009).

And if one wants to measure RBM's success by funds spent on malaria, their success is indeed massive. International funding of malaria research and control interventions has quadrupled over the last few years, it is estimated to have increased from US$249 million in 2004 to $1.1 billion in 2008 (RBM, 2008). But this is not only due to RBM's influence, but rather the result of a broader re-organisation within international global health funding, and the emergence of other new, important organisations. Shortly after RBM, a second PPP entered the stage in global health: In 2001 *The Global Fund against HIV/AIDS, Tuberculosis and Malaria* (The Global Fund or GFTAM) was established as a major international funding initiative against the 'big three' killer diseases in the world. The Global Fund currently receives most of its resources through voluntary governmental donations, but the initiative "represents a new approach to international health financing" (GFATM Webpage, 2009) and is open to both private donations as well as "innovative financing" schemes[35].

Today, the biggest share of funding for implementation of malaria control is provided by GFATM. It is the "world's largest external source of finance for malaria control programs, providing two-thirds of all international financing. To date, the Global Fund has approved grants with a total value of US$ 2.6 billion over five years to 117 programs in 85 countries to support aggressive interventions against malaria. US$ 833 million has been disbursed so far" (GFATM, 2006: unnumbered). In 2008 alone, GFATM received a total of 2.15 billion US Dollars in donations.

---

[35] Such as Debt2Health, see http://ilfondoglobale.org/en/innovativefinancing/debt2health/

And thus by now, the Global Fund is indispensable when it comes to procurement of artemisinin combined therapy (ACT) malaria medication in developing countries, and has financially enabled the shift towards ACTs. In total, the Global Fund has so far funded the delivery of 74 million drug treatments (GFATM Webpage, 2009). Since April 2009 it also hosts the *Affordable Medicines Facility for malaria* (AMFm), which is the first worldwide subsidy system for ACTs, and through this aims to widen access to malaria medication in sub-Saharan Africa. But the Global Fund also supports other interventions against malaria. For instance, 70 million bednets have been distributed to populations at risk of malaria in 140 countries with support of the the Global Fund (GFATM Webpage, 2009). Ghana has been the recipient of three GFTAM grants in malaria control so far: $8,8 million in Round 2 in 2003, $38,8 million in Round 4 in 2005, both of which mainly funded ACT implementation. In late 2008 Ghana announced its fourth successful bid to the fund, the biggest so far with $158 million. The majority of this grant is going towards a rather new intervention for the Global Fund, it supports indoor-residual spraying (IRS)[36].

But there is a third major player, fairly new on the global public health scene, with a significant impact on malaria control policies today. In 1999 the *Bill and Melinda Gates Foundation* (Gates Foundation or BMGF) emerged and its financial investment and influence in global health grew quickly. It is today the largest charitable organisation in the world, with an endowment of US $29.7 billion as of January 2009. As one can read on their webpage, the foundation's main aim is to bring “innovations in health and learning to the global community” (BMGF Webpage, 2009). Their engagement in global health receives considerable media attention, not least because the foundation has gained major influence on configurations in global health.

---

[36] More about this grant in *Chapter 3.7*.

Malaria has become one of their *cause célèbre* and the importance of the Gates Foundation in international malaria control is not to be underestimated. The Gates Foundation today invests considerably into the fight against malaria: approximately $3 billion dollars per year. In comparison to this sum "the WHO's malaria budget for 2006 and 2007 seems laughable: $137.5 million, and not even half of that sum is certain" (Der Spiegel, 2006). One of the consequences of this unequal situation is that the WHO applies for funds at the Gates Foundation, rendering the influence of philanthropic organisations on global health questions immense. So far the WHO secured eight malaria related grants from Gates, amounting to US$ 63.2 million (BMGF Webpage, 2009).

Furthermore, in malaria related research and development (RandD) two organisations provide an estimated 40% of the total funding of US$422 million – the *US National Health Institute* and the *Bill and Melinda Gates Foundation*. In 2005, the Gates Foundation overtook the US governmental contribution: "Gates snatched the title of the largest single donor to malaria research in the world – an accolade previously held by the US Government" (Lancet, 2005: 1586). Additionally, even though the Global Fund is mainly financed by governments, the Gates Foundation also contributed US$100 million to it so far (GFATM, 2008). Although this does not represent a significant amount of the total GFATM funding, it signals an active involvement of the Gates Foundation. And considering these numbers, it should not be overly surprising that the Gates Foundation was instrumental in a recent shift from a "global malaria control paradigm" to a revival of a "malaria elimination/eradication agenda". The following section discusses the details of this shift.

4.3 An audacious goal: The re-emergence of malaria eradication

> If the malaria community had an Oscar week, this would be it. The luminaries who will begin meeting in Seattle today aren't likely to get red-carpet receptions, but

they represent one of the most high-powered groups ever assembled to fight the killer disease. The draw is an offer few health experts would refuse: an invitation from the Bill and Melinda Gates Foundation, the world's richest philanthropy and a major funder of malaria research and control programs. "It has become our version of Woodstock," said Dr. Kent Campbell, of the Seattle-based nonprofit PATH. "This is probably as competitive a ticket as the Bruce Springsteen concert." (Doughton, September 2007)

A couple of years after the renewed interest and engagement in malaria control, in autumn 2007 Bill and Melinda Gates hosted a *Malaria Forum* in Seattle. Attendance was by invitation only and invited were only the most important actors in international malaria control – a wide range of malaria scientists both from US-European research institutions and malarious countries, policy makers such as the Director-General of the WHO Margaret Chan, representatives of private companies involved in malaria control, as well as governmental representatives – such as the Zambian Minister of Health or the Chair of the UK All-Party Parliamentary Malaria Group. Researchers from Ghana were also present; one of them, Professor Fred Binka, was one of two people mentioned in Bill Gates' speech; he was celebrated for his achievements in malaria research and capacity building for scientific research in Africa[37].

At the event itself Melinda and Bill Gates surprised the assembled malaria community by announcing that their foundation is going to declare 'malaria eradication' as their aim. In the words of Bill Gates:

> It's a privilege for Melinda and me to host this conference and see so many

---

37 Binka is inter alia the founder of the INDEPTH network, which 'provides health and demographic data and research to enable developing countries to set health priorities and policies based on longitudinal evidence'. See: http://www.indepth-network.org/. INDEPTH Network has been founded in 1998.

people who are doing brilliant work on so many different aspects of this disease. If the parasite were as ingenious as they say, it would target this hall. There is no greater threat to the future of malaria than the energy and intelligence of the people here today. (...) What is the most repeated failure in all of global health? It could well be the commitment to eradicate malaria. So why would anyone want to follow a long line of failures by becoming the umpteenth person to declare the goal of eradicating malaria? There's one reason. We should declare the goal of eradicating malaria because we can eradicate malaria. Today, I want to make the case that we have a real chance to build the partnerships, generate the political will, and develop the scientific breakthroughs we need to end this disease. (Bill Gates, Malaria Forum, 2007)

But Bill Gates is a gentlemen, and so, Ladies first, his wife Melinda spoke before him and set the tone for her husband's speech. Melinda Gates emphasised that health for all people on the planet is an ethical imperative and deaths from malaria have to be stopped. And to her this is only achievable through the eradication of malaria. She was, however, careful to point out that the Gates Foundation is aware of the dangers an eradication approach encompasses, and that the timeline for eradication is long. Both she and Bill Gates affirmed that it is "an audacious goal", however, "to aspire to anything less is just far too timid a goal for the age we're in. It's a waste of the world's talent and intelligence, and it's wrong and unfair to the people, who are suffering from this disease" (Melinda Gates, 2007).

This commitment to eradication of an organisation that in recent years had grown to be one of the most powerful actors in malaria control, took many by surprise – especially the scientific community who are intimately familiar with the history of malaria control and the resilience of this complex disease. But this was not the only surprising positioning at this event. In the words of Science Magazine:

The second surprise came after the speeches, when Margaret Chan, director general of the World Health Organization (WHO) in Geneva, Switzerland, jumped up, grabbed a microphone, and enthusiastically seconded the idea. "I pledge WHO's commitment to move forward, and I dare you all to come along with us," she said, reportedly without consulting some of her senior lieutenants. (Roberts and Enserink, 2007: 1544)

For a while 'eradication' seemed to be the silent new paradigm, with not much said about it in the media, policy documents or scientific publications. This is changing; for instance in summer 2008 RBM launched a new global malaria strategy document called "The Global Malaria Action Plan – for a malaria free world" (RBM, 2008). These are the very ambitious aims of the strategy:

- *Achieve* **universal coverage**, as recently called for by the UN Secretary-General, for all populations at risk with locally appropriate interventions for prevention and case management by 2010 and *sustain* universal coverage until local field research suggests that coverage can gradually be targeted to high risk areas and seasons only, without risk of a generalized resurgence;
- *Reduce* global malaria **cases** from 2000 levels by 50% in 2010 and by 75% in 2015;
- *Reduce* global malaria **deaths** from 2000 levels by 50% in 2010 and to near zero preventable deaths in 2015;
- *Eliminate* malaria in 8-10 countries by 2015 and afterwards in all countries in the pre-elimination phase today; and
- In the long term, *eradicate* malaria world-wide by reducing the global incidence

to zero through progressive elimination in countries

(RBM, 2008: 12, emphasis in the original)

Thus, the Malaria Forum has been very influential: after the end of the global malaria eradication in 1969 few malaria experts would have expected 'the e-words' (as elimination and eradication are nicknamed in the malaria community) firmly back on the international agenda. The return to eradication is framed as a bold and "audacious" move to re-invigorate the optimism of science policy of the 1950s. But, as we have seen in *Section 4.1*, unlike the state-driven funding of the first eradication campaign, contemporary support for large-scale scientific endeavours is underpinned by public-private partnerships, international research collaborations and large-scale development donors. The GMAP will be a complex balancing act, which is supposed to be held together through the global action plan and its common aims and targets. Just like the *Millennium Development Goals*, however, the performative effect of such targets sometimes seems to be more important than their actual achievability; in the words of RBM's executive director Awa Marie Coll-Seck: "Ambitious goals and targets are an important driver of progress. They provide motivation and a horizon for improving one's lot" (Coll-Seck, 02/03/2010). However, the ambitious aims of the GMAP are not only difficult to achieve but also to measure.

A closer look at the production of numbers confirms this: For instance, the GMAP aims for a reduction of global malaria *cases* from 2000 levels by 50% in 2010. For the year 2000 RBM reports an estimated 350 to 500 million clinical episodes annually, which resulted in over one million deaths (RBM, 2008). In 2008 the World Malaria Report counts 247 million malaria cases worldwide in 2006, with an estimated 881,000 deaths worldwide (WHO, 2008a). Following these figures there seems reason for optimism, since the numbers seem to be dropping significantly. However, this is not as clear-cut as it seems, as an article in

The Economist nicely summarises and the WHO has pointed out itself (WHO, 2008b):

> Sadly, the bigger reason for the seeming drop in the total number of malaria cases is the way the WHO counts them, a tricky task in countries with weak health-care systems. Previous reports relied on estimates dating back to the 1950s and 1960s in some countries outside sub-Saharan Africa. The new methodology takes the actual number of malaria cases reported by local health authorities as a starting point. Nearly half the fall comes thanks to counting cases in India by the new method. (The Economist, 18/09/2008)

In addition, even though the new estimation method is a big step towards more accurate figures, reported cases are still only rough estimates – caught up between over-diagnosis of malaria and a high number of home-treated malaria cases, which escape the counting mechanism. The method in Africa remained the same in 2000 and 2008, and is even less substantial:

> For most countries in the African region, which is the hardest hit by the disease, estimates of the number of cases are based on long-term climate conditions gathered by satellite, since national surveillance systems are still too weak to provide enough reliable data. (The wetter and hotter the area, the greater the expected intensity of mosquito-borne malaria). (WHO, 2008c: 1)

This means that the numbers of malaria cases on the African continent are solely based on climate predictions and not real cases. Taking into consideration that by far most cases and deaths of malaria are assumed to happen in Africa (90% of malaria deaths, calculated by a similar method), in total these numbers cannot be seen as more than a rough orientation.

Thus, the challenges to measure and control malaria by far exceed the positive outlook of policy documents. Furthermore, policy documents usually do not convey the weaknesses of case numbers and estimates; the specification above is for instance 'hidden' in an appendix on methods.

One more aim of the GMAP merits brief attention here, namely the goal to "achieve malaria elimination in 8-10 countries by 2015". This aim focuses on countries where malaria transmission is unstable and/or low, and illustrates the logic of the eradication agenda more broadly. GMAP aims to build momentum for eradication through success in countries where elimination is comparatively easy to achieve. This sounds historically familiar; as has been shown in the last chapter, malaria elimination was achieved in countries with supportive external factors (such as Italy or USA). Countries with more challenging external conditions had nearly no sustainable benefits from the campaign (such as Sri Lanka).

Furthermore, this approach has aptly been titled "Shrinking the Malaria Map" by the newly founded *Malaria Elimination Research Group* (Feachem et al., 2009). Shrinking the map means closing in on malaria from the fringes, eliminating it from places with lower transmission and then working in towards the heart-lands of malaria in Western and Central Africa. This makes sense in order to build momentum as early success reports will keep funders motivated. However, such a strategy risks falling into the same trap the first eradication campaign fell in. In the 1950s campaign the costs were underestimated, which lowered enthusiasm from funders quickly and was one of reasons for the campaign's early abandonment. As Tanner and de Savigny outline, while it makes make sense strategically to concentrate on the fringes, this also has its drawbacks:

> Maintaining long-term momentum in the face of success in regional elimination while waiting to achieve final eradication will be a major challenge. Shrinking the map by starting on the malaria margins with the "easy-to-eliminate" settings will boost morale initially but may bring marginal benefits to such areas at the expense of those where the burden of malaria is highest. (Tanner and de Savigny, 2008: 82)

And, as one might want to add, we might be well advised not to forget that areas with the highest malaria burden also have the highest malaria death toll. Rural areas with stable high-level transmission and a weak (or nonexistent) public health infrastructure are particularly vulnerable to malaria. Often such areas have been systematically neglected by the state, are experiencing (long-term) violent conflict or are emerging out of conflict[38]. It is difficult for donor agencies to invest into robust development projects in such areas, and often health care entirely depends on international emergency aid organisations. Additionally, in areas with endemic and stable high-level malaria transmission mosquito and parasite ecologies have formed the most successful arrangements, and thus "by definition the most heavily affected areas are going to take the longest time to get rid of [malaria] and the odds are that they're also going to be the most difficult areas" (Hopkins quoted in Shiner, 24/04/2009).

Malaria experts have also pointed out repeatedly that eradication in Africa is not achievable with the current tools (Tanner and de Savigny, 2008; Lines, Whitty and Hansen, 2008). Thus, for many who have spent years working in public health, the immediate problem of an eradication program is that it will create false expectations, leading governments to abandon the mundane, budget-draining but ultimately effective control policies:

---

38 In Africa this would be areas such as Southern Sudan, Eastern DR Congo, or Sierra Leone and Liberia – once again malaria and war intersect.

> The notion of elimination by 2025 captured the imagination of the scientific community working on malaria, which moved in a short space of time from a realistic awareness of the enormity of the complex and seemingly insoluble problem of malaria control to cautious optimism that elimination by 2025 is a real possibility – the Emperor's New Clothes, perhaps? (Hommel, 2008: S1)

This section has introduced the re-emergence of a second malaria eradication campaign, briefly outlined the global malaria action plan, and discussed two major challenges of the current policy approach in global terms. But how does malaria control look in practice, and which interventions form part of the eradication mosaic? In the following sections I will briefly discuss the state of the art of the four current main interventions against malaria –namely, Indoor Residual Spraying (IRS), Insecticide Treated Nets (ITNs), Antimalarial Medication (ACTs) and malaria vaccine development– and sketch out their relevance for Ghanaian malaria control.

4. 4 Attempting an overview over current malaria control interventions

4.4.1 Indoor Residual Spraying (IRS)

As so often in history, the most significant discoveries are at least partly owed to coincidence. In 1942, Paul Russell, one of the most important malariologists at the time, "received a sample of DDT and 'on a hunch' sent it for testing 'as a possible larvicide'" (Listios, 1996: 73). It turned out that the highest effectiveness of dichloro-diphenyl-trichloroethane (DDT) did not lie with larvae but the hatched mosquitoes – DDT was discovered to be a highly potent insecticide. As *Chapter 3* showed, DDT revolutionised mosquito control over the decades that followed its discovery, and today is again an important, albeit controversial, tool of malaria control. It is not only highly effective but also

cheap, and its effect is long-lasting in comparison to other insecticides, which makes it popular for large-scale malaria control programmes. But nearly as fast as the insecticide had initially spread over the continents another phenomenon started to occur – insecticide resistance. The target of the insecticide, the *Anopheles* mosquitoes, slowly adapted to the intervention: before 1945 only a dozen species were known to be resistant to pre-DDT insecticides, but by 1960 already 139 species were estimated to be resistant against DDT (Carson, 1965). As we have seen, resistance made the eradication campaign less effective and constituted a major problem. It was, however, not the only one; the emergence of resistance against DDT also made public support crumble:

> When DDT did stop killing the pest insects, it was easy to understand that the reaction of the public was just as intense as before, but this time to express frustration and sometimes anger. (...) The report's attitude towards the public was consistent with the highly centralized, military-like campaign approach that characterized eradication. (Litsios, 1996:83/84).

After the abandonment of the eradication agenda, the public contestation of DDT's potentially toxic effects led to a ban on DDT. Very influential in the debate leading to the ban was Rachel Carson's book *Silent Spring* (1962), and the debate on DDT is by many remembered as the beginning of the 'green' or environmentalist movement. Hungary was the first country to officially ban DDT in 1968, the USA announced a DDT ban in 1972 (US EPA, 1972), and many countries worldwide followed suit. In 2001, DDT was included in the UN treaty *Stockholm Convention on Persistent Organic Pollutants*. However, after a number of malaria scientists lobbied for DDT, an exemption for the use of DDT for public health purposes was made in the convention (UN, 2001: 24). Officially, DDT was always allowed to be used in malaria control and on in small-scale projects always has been used, most

prominently to fight a malaria epidemic in South Africa from 1996 onwards (Overgaard et al, 2007: 632).

Nevertheless, DDT remained marginal as a tool for malaria control for many years after the abandonment of the first eradication campaign. This changed in 2005 when the *WHO Global Malaria Programme* appointed a new director, Dr. Arata Kochi, and with him insecticide spraying and DDT emerged again on the public agenda. While previously the WHO had recommended spraying only in malaria epidemics, it was re-launched in 2006 as a tool for areas with stable transmission. The use of insecticides is today restricted to controlled 'indoor residual spraying' (IRS) (WHO, 2006) and is hoped to contribute much to eliminating malaria. The restriction to indoor spraying is a consequence of the intense area-spraying campaigns of the 1950/60s and is a measure to prevent agricultural contamination (Kochi, 2006). Kochi addresses the contested history of DDT head-on in his press statement that re-launches DDT:

WHO Malaria Head to Environmentalists: "Help save African babies as you are helping to save the environment."

I am here today with one urgent message to everyone who cares about the environment. Your concern, your activism, your heroics have helped – and continue to help – protect the earth's wildlife and nature. I am here today to ask you, please: Help save African babies as you are helping to save the environment. African babies do not have a powerful movement like the environmental movement to champion their well-being. They need your help. (...) Some people told me that there was a good reason why its wide scale use had been phased out. I was told the practice was unsafe for humans, birds, fish and wildlife; that the use of DDT in the United States in the 1950s had led to the near

> extinction of the bald eagle. I was told that indoor spraying with DDT was "politically unpopular." But I believe that public health policies must be based on the science and the data, not on conventional wisdom or politics. (Kochi, 2006:1)

Interestingly, the big public debate or even outcry from environmentalists or other concerned people that Kochi seems to have expected, and which one could well have expected after the infamous debate about it in the 1960s, never took place. The broad reintroduction of DDT remained fairly uncontested. There are notable exceptions: In Uganda, the *Uganda Network on Toxic Free Malaria Control* (UNETMAC) has taken the government to court over the use of DDT, arguing that while controlled DDT spraying works in certain situations, the overall risks to human health and the environment are too high. The country had started insecticide spraying with DDT in February 2008, which prompted UNETMAC to take court action; in May 2008 the Ugandan High Court halted the spraying, but dismissed the case in April 2009, and spraying has by now resumed in the country (Bugembe, 17/07/2009). Surprisingly though, it was not only environmentalists that expressed concerns over DDT in Uganda, 52 companies had also issued a statement in which they asked the government to delay the implementation of DDT. The companies, one of them British American Tobacco, warn that "the use of DDT could threaten lucrative exports of tobacco, coffee, cut flowers and other agricultural products" (Taipei Times, 09/10/2006). Products that contain traces of DDT cannot be imported into countries that have signed *The Stockholm Convention on Persistent Organic Pollutants,* and so the companies have reason to fear about their business. Nevertheless, to see British American Tobacco and environmentalists agree is a rather unfamiliar sight.

Scientifically, the debate environmental and health dangers of DDT has never been clear-cut. It is undisputed that DDT is highly persistent in the environment, it potentially lasts in

soil for hundreds of years (US Dep. of Health, 2002: 3). And DDT likes to travel: it "can be carried long distances in the atmosphere. These chemicals have been found in bogs, snow, and animals in the Arctic and Antarctic regions, far from where they were ever used" (ibid). Generally, DDT tends "to bioconcentrate (particularly in aquatic organisms); they accumulate in fatty tissues; and they are transferred through the food chain. The well-publicized link between high levels of DDT in birds and subsequent reproductive problems (such as thin-shelled eggs) made DDT a household word" (Harte et al., 1991: 286). DDT further biomagnifies, which means its concentration increases as it moves up the food chain. It works primarily as a toxin on the nervous system, not only of insects but also of mammals. And this led to unexpected side-effects during DDT's high-times: biomagnification of DDT was responsible for the thinning of egg shells in the America's bald eagle, whose slow dying-out was documented in Rachel Carson's book. Meanwhile in Indonesia another side-effect of DDT caused people to banish malaria workers from their villages:

> The strange phenomenon of their roofs collapsing within a month of their houses being sprayed with DDT. Malaria they knew, but falling roofs were something else again, and the sophisticated biological explanations offered by the malaria workers didn't put back cover on their house. What was happening was that the roofs were made of *attap (palm fronds)* and there was an *attap*-devouring caterpillar that dwelt in the roof. Under normal conditions a parasitic wasp preyed on the caterpillars and kept the pests at low, non-destructive numbers. Unfortunately, the wasp was highly sensitive to DDT while the caterpillar was resistant. The malaria workers sprayed the houses, the wasps died, the caterpillars proliferated... and the roofs came tumbling down. (Desowitz, 1991: 140)

Today, the scientific debate about health and environmental effects of DDT is still not settled. While WHO explains that "fears of its harmful effects on the environment and on human health are unjustified when DDT is used appropriately for IRS" (WHO, 2006: 2), annual DDT spraying in areas of South Africa has triggered recent studies on its environmental and health effects. For instance, Barnhoorn et al. found DDT residues in fish, chicken and wild birds, and conclude that the "findings raise concern that both water and food may be major routes of human exposure to DDT and metabolites, thereby posing possible adverse human health implications to the local communities" (Barnhoorn et al, 2009: 1236). Sereda et al. investigated DDT and pyrethroid residues in breast milk, and found that DDT levels in breast milk of mothers, who lived in a sprayed area were much higher than in non-exposed mothers. Since both groups of mothers used the same food markets, the results mean that intake of DDT was "most likely through air and skin contact, and excludes food as a main source of pollutants" (Sereda et al, 2009: 897). Both studies register concerns over health effects, and argue for more regulation as well as a careful investigation of the dynamics between DDT's mode of action and the livelihoods in sprayed areas.

While South Africa never really stopped DDT spraying, the technique was marginal in most other African countries for decades. The move back to DDT and spraying only gathered momentum all over the African continent again when it was picked up by one of the influential international donors. In June 2005, President Bush launched the *President's Malaria Initiative* (PMI), which aims to reduce the burden of malaria by 50% in its 15 focus countries in sub-Saharan Africa. PMI officially belongs to US AID and one of its main tools in the fight against malaria is IRS. Shortly after WHO's decision, US AID officially endorsed DDT again (Mandavilli, 2006: 870). And, in the 15 PMI countries and many other African

countries IRS with DDT is today common practice again. Ghana however, has not lifted its ban on DDT, the Ghanaian *Environmental Protection Agency* (EPA) justifies this as follows:

> DDT, which was widely used in Ghana for agricultural and public health purposes, was officially banned in 1985 due to its damaging effects on human health and the environment. (...) Based on the above, the EPA recommends that the Government of Ghana should resist any external pressures to re-introduce DDT into the country since equally effective alternatives have been approved for use in the country. The use of these alternative pesticides should be intensified to control malaria in the country. The Stockholm Convention only recommends the use of DDT if safe, effective and affordable alternatives are not locally available in a country. (EPA Ghana, 2006)

In the past, DDT was used in Ghana not for malaria control, but mainly for spraying on cocoa plantations, and this might be the reason why the Ghanian state has not released DDT again. As one of my interviewees speculated the EPA and government feared DDT would spill over to cocoa plantations, endangering chocolate exports, which is the country's most important agricultural crop (Interview, 2007; for more on this see *Chapter 7.3*). But while DDT is not used in Ghana, IRS with other insecticides has increased considerably over the last years in Ghana too. As will be discussed in detail in *Chapter 6*, the gold-mining company AngloGold Ashanti (AGA) has started to spray the Ghanian city of Obuasi in 2006. Furthermore, Ghana is one of PMI's focus countries, and since 2008 PMI has conducted IRS in five districts around Tamale in the Northern Region of Ghana. In 2008, Ghana has also successfully applied for a grant from the Global Fund, in order to scale up malaria control interventions that will cost US$ 158 million for five years (GFATM, 2008: 25). IRS is

the main intervention, and represents $122 million of the Global Fund's investment (ibid: 77).

Thus, recent efforts at vector control in Ghana (and worldwide) rely increasingly on insecticide spraying. However, as insecticide resistant mosquitoes have already demonstrated in the 1950s, insects evolve and adapt fast. This makes spraying in the age of resistance a complex endeavour and creates specific challenges, not only from a technical but also from a social perspective. This and the relationship between vector ecology and public engagement will be explored more in *Chapter 6*. The following section will introduce mosquito nets as a malaria control strategy.

4.4.2 Mosquito Nets (ITNS/LLNS)

The use of mosquito- or bednets to protect oneself from bites has a long tradition and is connected to a set of rather low-tech cultural practices such as the habit of "turtling", the hiding of one's head under the bed cover (Schumaker, 2000: 709). Today, mosquito nets are high-tech products impregnated with insecticides in order to enhance protection. These insecticide-treated Nets (ITNs), or in their newest version long-lasting insecticide-treated nets (LLIN),[39] have over the last years gained support from all major international malaria initiatives as an effective, sustainable and low-cost means to prevent malaria.

Entomological models for sub-Saharan Africa, where mosquito bites usually peak between 10-12pm, suggest that ITNs should prevent more than 75% of anopheline bites (Pates and Curtis, 2005: 59). Together with studies in The Gambia (Alonso et al., 1991; D'Alessandro et al., 1995) and Kenya (Nevill et al., 1996), Ghana was involved in one of the first field trials of

---

[39] The difference between the two is the durability of the insecticide on the net, ITNs have to be re-treated regularly after washing, whereas LLINs are meant to last 3 years without re-treatment. To simplify I will in the following stick with the more popular abbreviation ITNs.

ITNs (Binka et al., 1996). In all field studies ITNs achieved a substantial reduction in mortality from malaria, and the results of these studies have significantly contributed to the shift in international health policy and donor preferences in malaria control (Curtis et al., 1996)[40].

Since then ITNs have quickly emerged as the figurehead of international malaria control. For instance, at their creation in 1998 RBM pledged to half malaria incidences by 2010, mainly through reliance on ITNs. Equally, the webpage of the Global Fund announces that it has so far distributed 70 million ITNs. By now, many organisations and NGOs have made it their aim to distribute as many ITNs in sub-Saharan Africa as possible. Indeed, "universal coverage" of ITNs in malarious regions forms a core part of the new eradication strategy (RBM, 2008). This might also be because ITNs are also considered to work everywhere and be comparatively easy to implement logistically:

> In very low income countries it is not possible routinely to meet the logistical demands of ensuring that trained spray teams equipped with working spray pumps and sufficient insecticide arrive at each village in time to spray before the malaria season. It can also be argued that it is more feasible to supply ITNs in such circumstances because this does not impose similar logistics requirements (WHO Bulletin, 2008: 9).

And, as everywhere on the African continent, ITN coverage has increased considerably in Ghana in recent years.[41] The WHO country report states: "The NMCP programme distributed 3.6 million LLINs in 2006–2007. 30% of households owned a mosquito net in

---

[40] The US AID conference on bed nets, 1997, http://www.malaria.org/bnets/index.htm; WHO Africa Framework for the promotion of large-scale use of insecticide-treated nets and other materials in the African Region, 1999, http://www.who.int/malaria/docs/harare99-1.htm were other relevant events that contributed to the shift towards ITNs as large-scale control tool.

[41] More on the problematic relationship between distributed/sold nets and their usage in *Chapter 7.3*.

2006, but only 19% owned at least one ITN" (WHO, 2008b: 72). There are two main ways how insecticide-treated bed nets got sold and distributed in Ghana in 2007/08. Firstly, there was the annual *National Integrated Maternal and Child Health Care Campaign*. Every year the campaign provides ITNs for free for children between 0-11 months, polio vaccination for children 0-59 months, de-worming for children between 2-5, Vitamin A for 6-59 months year olds and new mothers (until 8 weeks after delivery). Additionally, in 2007 the campaign offered a free *National Health Insurance Scheme* registration for children under 1 year of age.

Figure 8: Banner announcing the NIMCP 2007 in Agogo

While the campaign is coordinated by the MoH, UNICEF supports it by covering districts in Ghana's Northern region and providing logistical support to the Ministry. In 2006 the campaign distributed 2.1 million nets, in 2007 it was 1.5 million. The nets in 2007 came from

three sources: firstly, DFID contributed £2.7 million, which paid for about 600,000 ITNs, and secondly UNICEF received ITNs worth US$1 million from the Japanese government. The third portion of ITNs –700,000 nets– came from the World Bank through the MoH. However, the nets from the WorldBank were delayed, and still on the ship at the time of the national distribution. People instead got vouchers and were able to collect the ITNs later on[42].

"Vouchers" bring us the second big initiative distributing ITNs. The initiative is a public-private partnership called *NetMark*. NetMark has been founded by US AID, and is active in eight African countries, Ghana is one of them. NetMark aims to "reduce the burden of malaria in sub-Saharan Africa by increasing the commercial supply of and public demand for insecticide treated nets" (NetMark Website, 2007). They work with commercial partners as well as the NMCP in order to create a market for ITNs. In Ghana they inter alia run a voucher system, where pregnant mothers attending ante-natal care get counselling on ITNs and a voucher of 4 GHC[43], which is supposed to enable them to buy ITNs for approximately half of the market prize from commercial outlets such as chemical shops, supermarkets, pharmacies as well as 'umbrella women'[44].

NetMark's role is to organise the commercial partners; they are a bridge between the field and the companies, taking care that commercial outlets selling ITNs are widely spread throughout the country. When I visit the country coordinator of NetMark in Ghana, I learn that while they work with clinics and other public health institutions the initiative is predominately concerned with building a commercial ITN market. In this regard he tells me

---

42 The delay made the process more vulnerable to fraud etc, but I witnessed the issuing of vouchers in Agogo sub-district and when I came back some months later, the late WB nets had been distributed. However, it is not likely that the same population was reached again, since it was this time only distributed through the routine immunisation process, whereas the national campaign aims to cover everyone and hence had more outreach teams working who diligently went through communities to recruit people and marked covered houses in order to document coverage. It is hence likely that some people did not receive nets because they were not able to attend the routine immunization.

43 At the time I was in Ghana there was an upward review of this amount happening, the subsidy has by now increased to 6 GHC per net.

44 Little street shops on the roadside mainly consisting of a table, an umbrella and a (often female) or young person selling goods, these days mainly mobile phone credit.

that 'choice' is very important to them, because this will increase the individual commitment to the nets. Thus, NetMark offers nets in all shapes and sizes. One can buy rectangular or circular nets, soft or hard ones, white, blue, green and pink nets, as well as student, standard or king size products. This contrasts with the free distributions, which only offers in one size for all.

In my conversation with the coordinator at the NMCP, I ask why there are two systems at work. She answers that this is because of potential 'donor fatigue'. She argues that with the help of NetMark's work, Ghana would have an established commercial distribution system in the town and villages, even if donors get tired of funding ITNs at some point. Interestingly, to my interviewee the commercial system is the more sustainable system when compared to a public health system, whose capacity entirely depends on donors: "NetMark is a way to keep the (commercial) partners on board", she says, "especially considering that donations of ITNs are often a marketing strategy, which won't happen endlessly"[45]. In addition to those two ways of organised ITN distribution, one can also buy ITNs on the unsubsidised, open commercial market. Unsubsidised ITNs cost between 8-10GHC, and I have seen them on display in the big pharmacies in cities and in fewer quantities (one or two odd ones) in general stores or market stalls. However, the challenges of ITNs exceed the distribution and the creation of a functioning and affordable market by far, and the subtle and not so subtle challenges that ITNs pose will be discussed in depth in *Chapter 7*. The following section outlines the role of antimalarial drugs in malaria control.

4.4.3 Antimalarial Drugs

Even though the development of resistance had considerable impact on vector control techniques, arguably the impact on antimalarial drugs was even greater. Until recently,

---

[45] See *Chapter 7.2* for more on ITN markets and their dynamics.

chloroquine was worldwide the first-line malaria treatment. Chloroquine was developed in 1934 by the pharmaceutical company Bayer and as a very cheap drug with comparably mild side effects; it was very popular and widely used. White (2007) states that chloroquine might in fact be the most widely used drug of all time, and so for a long time it seemed that chloroquine would make malaria deaths entirely avoidable. From the 1950s onwards, however, the situation slowly changed. As the *Introduction* already discussed, resistance against chloroquine was first reported along both the Panama-Colombian and Thai-Cambodian borders. While the first mutation rapidly spread throughout the Amazon region – southwards to Bolivia in the early 1960s and extending to the Atlantic coast of French Guiana and Surinam by the early 1970s– the second mutation in Asia took 10 years to reach across Thailand to Burma, and started to occur in central India not until the late 1970s (Plowe, 2008: S12).

While the mutation that emerged in South America remained contained on the continent, it has been proven that the genetic mutation from Asia spread to Africa. Chloroquine resistance was first reported from East Africa in 1978 and from there slowly moved westward across the continent (ibid.). Drug resistance is the reason why the non-profit organisation *Medicines for Malaria Venture* (MVV) has described it as one of their main goals to work towards a "sustainable pipeline" of antimalarials (MVV, 2005). A sustainable pipeline means that, in the light of resistance, new drugs have to be developed continuously. Resistance is also the reason why so called "combination drugs", which combine different active ingredients in order to slow resistance down, have been introduced internationally. Today chloroquine treatment "now fails almost everywhere" (Greenwood et al., 2005: 1491), and since 2001 chloroquine started to be phased out in malarious countries and to be replaced by artemisinin-combination therapy (ACT).

Artemisinin is derived from a Chinese herb – *Artemisia annua*, also known as *sweet wormwood* or in Chinese as *qīnghāo*. Artemisia has been used to treat fever in China and South-East Asia for centuries, while the active ingredient artemisinin was only isolated by Chinese researchers around 1967 as part of a "systematic examination of plant species used in TCM in order to discover new drugs, especially for malaria" (Yu and Zhong 2002: 150)[46]. The discovery quickly received attention from WHO and Western malaria scientists, but only in the 1990s became of public health importance internationally. In order to slow resistances down, WHO decided to combine artemisinin with other malaria drugs, and until today artemisinin-combination therapy (ACT) is the recommended first-line treatment against malaria worldwide. Artemisinin can so far not be synthesised chemically, and so the artemisia plant is grown on plantations, harvested and then processed into pill form. Major efforts are under way to produce artemisinin synthetically; the drug is the flagship project of synthetic biology – as *Nature Biotechnology* in its news section summarised the developments in 2005:

> The most significant development of the field for industry so far has been the allocation of $42.6 million to a synthetic biology team to produce the malaria drug artemisinin by the Seattle-based Bill and Melinda Gates Foundation. The grant has been jointly allocated to the University of California (UC)-Berkeley, Amyris Biotechnologies of Emeryville, California and the Institute for OneWorld Health, a nonprofit drug development outfit in San Francisco. The move could have wider repercussions should the team be successful in producing the drug. (Herrera, 2005: 270)

---

[46] According to White (2002) the discovery of artemisinin was probably triggered by the Vietnam War. During this time the US army developed mefloquine (Lariam) as a new effective treatment against chloroquine-resistant parasites in the SE Asia. But research in China yielded even more important results: "The Vietnam War provoked a major Chinese initiative to develop new antimalarial drugs, and the most important discovery to emerge from this productive era was qinghaosu or artemisinin". (White 2002, http://malaria.wellcome.ac.uk/print/WTD023860_print.html

It is hoped that if one is able to produce artemisinin in the lab, not only will the production costs go down significantly, but also scientists would be able to engineer small changes in the chemical structure of the drug that counter-act resistance. As outlined in the *Introduction*, the year 2008 brought bad news for malaria drug treatment when the first cases of artemisinin-resistant malaria were confirmed in Cambodia (Noedl et al., 2008; Dondorp et al., 2009). Resistance has since then –while massive containment efforts by WHO, BMGF and others are only starting up– spread to China, Myanmar and Vietnam (MalariaConsortium, Nov 09). Despite the spread, resistance against artemisinin is not a major problem for malaria treatment on a global scale yet, but the drug remains the only malaria treatment that is both highly effective and without major side-effects (as for instance quinine has). If artemisinin were to become less effective, the global malaria treatment is endangered yet again. This danger is hoped to be alleviated by the development of synthetic artemisinin-based drugs. However, this discussion is complicated by the fact that artemisia plantations today form the basis of livelihoods for many poor farmers in South-East Asia and East Africa, which would fall away again if it was possible to produce artemisinin chemically.

Moreover, today the most pressing challenge for ACTs continues to be access to drugs; the *World Malaria Report 2008* states that only 3% of African children received ACTs (WHO, 2008). ACTs are approximately ten times more expensive than chloroquine, which makes the implementation a hugely challenging policy process – especially for sub-Saharan Africa. The vast majority of malaria patients in sub-Saharan Africa are not able to afford treatment with ACTs, and uptake has been slow and remains low, which made an international subsidy for ACTs necessary. Policy processes, however, have a different temporality than mutating parasites: with a bit of ironic timing, a few months after the first artemisinin resistance was confirmed in Cambodia/Thailand, the *Affordable Medicines Facility malaria* (AMFm)

launched mid April 2009 in Oslo, Norway. The aim of the AMFm is to increase the uptake of artemisinin-based combination therapy by reducing the price to chloroquine-levels (Coll-Seck, 2007). In the AMFm's own words:

> The Facility will help to save lives and reduce the use of less-effective malaria treatments. By increasing access to ACTs and displacing artemisinin monotherapies from the market, the Facility also seeks to delay resistance to the active pharmaceutical ingredient, artemisinin. (AMFm, 2009)

The proposal to subsidise ACTs has first been made in the publication 'Saving lives, buying time' (Arrow et al 2004), was subsequently taken up by Roll Back Malaria, but it took RBM several years to develop the idea and find funding mechanisms as well as a hosting organisation (Coll-Seck 2007). Four years later, AMFm is finally launched, it is hosted by the Global Fund and at the moment financed by contributions from UNITAID and the UK government. In its first phase it offers the subsidy to eleven selected countries, and Ghana is one of them. The establishment of AMFm came several years after the official and practical introduction of ACTs and is testament to the continued problems of access to ACTs in many countries. But how did the initial introduction of ACTs internationally take place?

By 2001 chloroquine-resistant parasites had broadened their borders so widely that WHO recommended all countries experiencing drug resistance to change to the newly developed treatment regime, artemisinin-combined therapy (ACTs). However, at first this remained a recommendation and the *Global Fund* as the biggest international funder of malaria control still gave out funds for mono-therapy as Attaran et al. criticise in an opinion piece in *The Lancet* in January 2004:

WHO violates its own policy standard regularly. Most African countries reluctantly cling to chloroquine, sulfadoxine-pyrimethamine, or the insignificantly better combination of chloroquine and sulfadoxinepyrimethamine, because ACT is ten times more expensive and, therefore, unaffordable to them. When those same countries seek financial aid from the Global Fund for AIDS, Tuberculosis, and Malaria (The Global Fund) to purchase ACT, they are forcefully pressured out of it by governments such as the USA, whose aid officials say that ACT is too expensive and "not ready for prime time". WHO acquiesces to this pressure to cut costs, and despite a policy that names ACT as the gold standard of treatment, WHO signs its approval when The Global Fund funds cheap but ineffective chloroquine or sulfadoxine-pyrimethamine to treat *P falciparum* malaria. (Attarran et al., 2004: 238)

This article has been very influential in the malaria community and arguably has led to the tightening of policies by WHO and the Global Fund[47]. Most importantly, the Global Fund started to provide assistance for implementing countries (mainly by stocking arthemeter-lumefantrine (Coartem) and providing it as part of their grants to kick off ACT usage). And this is how 2004 became the year of the shift to ACTs in sub-Saharan Africa. Ghana was part of this shift towards ACTs, the country officially introduced an ACT malaria policy in 2004.

However, the process in Ghana had started earlier; in 2003 researchers from the *Noguchi Memorial Institute for Medical Research* at the University of Ghana tested the efficacy of different antimalarial drugs (Koram et al, 2005). They compared chloroquine (CHQ),

---

[47] It is to note that this opinion piece has been followed up on and backed by several other malaria scientists in the following issues of *The Lancet*. Criticism however attracted Attaran's affiliation with Novartis, the producer of the first ACT, for whom he served as an adviser.

sulphadoxine-pyrimethamine (SP), amodiaquine-artesunate (ADQ+ART) and artemether-lumefantrine (Coartem), attested a "markedly failing efficacy of CHQ" (ibid: 201) and attributed the highest cure rates to the two ACTs (ADQ+ART and Coartem), with amodiaquine-artesunate having slightly better cure rates. The scientific study was requested by the Ghanian Ministry of Health and fed directly into the policy deliberation process, which included a broad constituency of Ghanian public health actors from MoH, NMCP, malaria scientists as well as NGO representatives. Following this process, Ghana published its new 'Anti-Malaria Drug Policy for Ghana' in November 2004. The policy change from chloroquine to artesunate-amodiaquine as first-line treatment took effect in January 2005.

Unexpectedly, this decision led to "the biggest public health scandal in Ghana," as one of my informants called it. Already briefly after the introduction people started to report severe side-effects to amodiaquine. A lively controversy started, of which many people tell me, and which is still in the memories of everyone. There was massive radio and media coverage at the time, and in December 2005 the Ghana Health Service (GHS) announced:

> The health authorities announced on Friday that single tablets of the new malaria drug, artesunate-amodiaquine, which contain 600 mg of amodiaquine and 200 mg of artesunate formulations, should be withdrawn until additional safety tests are done. The decision was reached at a meeting convened by the Minister of Health, Major (Rtd) Courage Quashigah on Thursday following concerns expressed by the media and individuals about the safety and efficacy of the new drug combination for the management of uncomplicated malaria. The policy change took off in January this year. (...) The Ministry of Health wishes to emphasise that the efficacy of the artesunate-amodiaquine drug in the treatment of

uncomplicated malaria is not in question and local as well as international efficacy studies confirm this. We wish to indicate that the adverse reactions reported so far appear to be linked to the formulations containing 600mg amodiaquine and 200mg artesunate as single tablets. (GHS, 19/12/2005)

In effect there was only been local product on the market, which had wrong quantities of amodiaquine, and caused more severe side-effects than usual. But this product generated lasting damage for the reputation of ACTs, and particularly amodiaquine. In response to the scandal the NMCP stepped up their media campaign, produced posters, invested considerably in health worker training[48] and produced a two part TV series about malaria broadcast on Ghana's TV3 in 2007. Even though the crisis considerably lowered the public confidence in ACTs, Ghana was commended by the *American Society of Tropical Medicine and Hygiene* (ASTMH) for successfully dealing with the crisis and the steps the country had taken in order to ensure pharmacovigilance. ASTMH states that the crisis in Ghana has led to strengthened collaboration among government, regulators and the private sector to ensure safety and effectiveness drugs (Kwei, 19/11/07). Nevertheless, triggered through the public controversy, a revision of the malaria drug policy had to take place. The review committee decided to keep amodiaquine-artesunate as their first-line drug, but added two alternative drugs as second-line options, in case someone does not tolerate ADQ+ART well. In December 2007 the revision of the policy document was finished, but when I left Ghana in summer 2008 the document was still to be signed by the MoH.

The process to shift policy, public and private health care system as well as drug taking habits of a country is long and complex, it is in many ways still in progress in Ghana. While

---

[48] Even though training sessions on ACTs and their introduction had been designed by the NMCP and took place on national, district, regional and local levels for health care staff, the problems with the initial introduction have resulted in delays. The two teaching hospitals for instance had not officially received training by beginning of 2008, because they decided to wait until the revised policy kicks in (WHO Country Advisor Ghana, Interview, 2008).

the infusion of ACTs into the public health care system and commercial drug market has been achieved, challenges remain – the major one is affordability, to which the early stage inclusion of Ghana into the AMFm aims to address. Meanwhile though, malaria parasites are threatening these efforts through the development of resistance in South-East Asia. Many public health experts and major malaria donors (in particular the Gates Foundation) hope that this problem will be settled through the development of a malaria vaccine. This is subject of the following section.

4.4.4 Malaria Vaccine Development: the RTS,S Vaccine Trials

No vaccine against a parasitic disease exists today, even though research on a vaccine against malaria started as early as the beginning of the 20th century (Desowitz, 1991). However, despite many scientific efforts, no vaccine has proven to be both effective and non-toxic for humans as yet. Over recent years with the mapping of the genomes of humans and parasite, new possibilities within science have arisen, Ntoumi at al. (2007) characterise these opportunities as "mining the human and parasite genome":

> The sequencing of the human genome provides a new opportunity to determine the genetic traits that confer resistance to infection or disease. The identification of these traits can reveal immune responses, or host–parasite interactions, which may be useful for designing vaccines or new drugs. (...) The malaria parasites are well known for their ability to undergo antigenic variation, and in parallel to cause a diverse array of disease syndromes, including the severe syndromes that commonly cause death. Genome-based technologies are being harnessed to relate gene and protein expression levels, or genetic variation, to the parasite forms that are targets of protective immunity. (Ntoumi et al, 2007: 270)

And, arguably, these advances in scientific knowledge have lead to the about 30 potential malaria vaccine candidates that are currently under development. One of these vaccines, called RTS,S, is the first malaria vaccine candidate to reach Stage III of clinical trials. The vaccine was initially developed in *GlaxoSmithKline*'s laboratories in Belgium[49], went through initial test phases in Belgium, at the *Walter Reed Army Institute* in the USA, as well as a first field test in Africa in Mozambique, where it was tested on 2,022 children aged 1-4 years in a double-blind, randomized, controlled trial (Alsonso et al. 2004, 2005; Aponte et al. 2007). Phase IIb of the trial has recently been concluded, which was conducted from October 2006 – 2008 in several African countries.

One of the trial locations for phase IIb was Ghana. Here, the vaccine was tested on 540 children aged between 5 and 17 months. The trials were conducted at two locations, one is Kintampo in the Brong Ahafo Region, the trials here were supervised by the *Kintampo Health Research Centre* (KHRC)[50], and the second is Agogo in the Ashanti Region, under the supervision of *Kumasi Centre for Collaborative Research in Tropical Medicine* (KCCR)[51]. The trials are now moving to Stage III and both KHRC and KCCR are involved again. Stage III trials are much bigger in scale, in Ghana alone the vaccine will get tested on over 1,000 children per location.

---

[49] In January 2010 GSK has made international headlines because it decided to release its database with all research results on malaria (for instance The Guardian, 20/01/2010 reports "Glaxo offers free access to potential malaria cures"). This move, has however to be interpreted within a broader strategy change within towards markets in developing markets, which are characterised by different scale. Multinational pharmaceuticals are discovering the so called 'low-margin, high-volume markets', where a small profit with a product that can potentially be sold to one billion Africans endangered by malaria, might well be worth the effort (Management Today, 01/03/2010: "Can GlaxoSmithKline take its medicine?"). Hence, if the CEO Andrew Witty claims in *The Guardian* that the move of opening their database, and focus more on 'neglected diseases' is "to earn trust from society", there is good reason to be sceptical about such claims.

[50] See http://www.ghana-khrc.org/

[51] See http://www.bni.uni-hamburg.de/bni/kccr/

The RTS,S trials are financed and coordinated by the public-private partnership *PATH Malaria Vaccine Initiative* (MVI), which is funded by the *Gates Foundation*, and whose aim is "to accelerate the development of promising malaria vaccines and ensure their availability and accessibility in the developing world" (MVI Factsheet, 2008). Generally, the malaria vaccine trials are one of the first large-scale vaccine trials happening on the African continent[52]. In order to adhere to international standards of trial regulation, a capacity building component has been important to the international consortium conducting the trials: funding from *Gates Foundation* enabled the establishment of a *Malaria Clinical Trial Alliance* (MCTA), which is run under the umbrella of the INDEPTH Network, a Ghana-based organisation. MCTA and MVI conduct 'Good Clinical Practice' training for health workers involved in all stages of the trials – from doctors, nurses, fieldworkers, malaria microscopists to trial management staff. The trial locations in Ghana have also benefited from new infrastructure, such as better equipment for laboratories. Such capacity building is an advantage for the participating hospitals. On the other hand, such investments in selected hospitals are tied closely to research-trial institutions, which re-enforces unequal geographies of health care infrastructure and provision in developing countries[53].

Scientifically, the fact that malaria vaccine trials are moving towards a first large-scale testing Phase III is testament to the success of RTS,S. However, the medical success is double-edged. The results of immogenicity tests were encouraging, most recently showing an efficacy rate of roughly 50% for the vaccine (Bejon at al., 2008: 2521). Thus, the tested vaccine currently conveys partial protection of roughly 50% against malaria. RTS,S will not prevent malaria entirely, it will rather be a vaccination conveying "partial immunisation". This

---

52 As Adriana Petryna explores in her extensive ethnographic study of clinical studies in Brazil, Poland, the USA and their global movements "When experiments travel" (2009), clinical trials have not only been rising in numbers, but are also increasingly conducted in low-income settings. For instance, in 2004 GSK run 29% of its trials outside the USA and Western Europe, in 2007 it was more than 50% (ibid: 13).

53 For a discussion of these issues relating to the RTS,S trials in Kisumu, Kenya see "'Under one Roof'- Negotiating Difference in Public Health Facilities Hosting Malaria Research" (Chantler et al, forthcoming).

means the vaccination will make the disease less severe, pushing the immunity levels of a child up roughly to the levels of an adult, who has already successfully lived through a malaria infection. This is, at first glance for a non-specialist, a disappointing result. However, it can make the crucial difference in practice. Considering that the overwhelming majority of malaria deaths occur in African children under 5 years, a partially effective vaccine would enable children to survive their first malaria infections and so prevent many malaria deaths. It remains to be seen how the Stage III of the trials will go, which have just started at (inter alia) Kintampo and Agogo in Ghana.

But, even if the vaccine is only going to be partially effective, it is hoped that it will contribute much to the renewed eradication agenda and to shrinking malaria's map. Especially so, because experts are aware that eradicating malaria in Africa is not achievable with the current tools of ITNs, IRS and ACTs (Tanner and de Savigny, 2008: 82; Lines, Whitty and Hansen, 2008). The hope is that scaled-up general interventions, which are supplemented by a widely implemented partial vaccine, could break malaria transmission even in high-transmission settings[54]. Nevertheless, not even vaccines are immune to resistance. As for instance experiments in mice have shown, malaria vaccines can drive parasite evolution and make the disease more virulent for non-immune people (Mackinnon and Read, 2004). In any case, as of yet vaccines play only a very partial role in applied malaria control, and this is through conveying partial immunity to the roughly 16,000 children taking part in the clinical trials in seven countries across sub-Saharan Africa – mainly they are a hope of the future and a major RandD enterprise.

This chapter has provided an introduction to financial and organisational configurations in malaria control, as well as briefly outlined the current global malaria policy and its four major

---

[54] Of course, the question if broad vaccination with a malaria vaccine in sub-Saharan Africa is economically realistic is not clear-cut either. Especially so because the vaccine would probably need frequent boosters to remain effective.

control tools. We have seen, that, while the strategies in today's renewed malaria eradication attempt are multiple rather than solely reliant on DDT, technological innovations and interventions still dominate the global agenda. The following chapters tell three stories about malaria, and draw on empirical material generated throughout the fieldwork in Ghana. The following *Chapter 5* discusses a concrete malaria control intervention, an insecticide spraying project conducted by a gold-mining company in a city in Ghana. Analytically the chapter proposes to understand the public health intervention as a "real-world experiment" and outlines the consequences of such a re-reading of the project. *Chapter 6* zooms out from one specific malaria control intervention again, and inquires into definitions of malaria. The chapter aims to embed our understanding of what malaria is thoroughly in the practices that constitute it – practices of patients, scientists, mosquitoes and parasites. *Chapter 7* then comes back to discussing one specific intervention against malaria, in this chapter insecticide-treated bednets. It situates the tool in its political, economic, social and entomological realities and argues that a performative understanding of bednets enables us to re-embed it within a broader context of wellbeing and development that escapes malaria policies. But firstly, in the next *Chapter 5*, we will dive into the everyday work of insecticide spraying in Obuasi, Ghana.

Chapter 5:

Insecticide spraying as a real-world experiment

Wo Kum Apem A, Apem Beba

When you kill thousands, thousands will come[55]

Motto of the football club *Asante Kotoko* Kumasi

5.1 The Blue Warriors

7.30am, Company Premises AngloGold Ashanti, Obuasi.

Morning briefing.

116 men in blue overalls sit on tables; in the front the team leaders, supervisors as well as the deputy programme manager gather. Martin, the manager, begins the daily morning address, in which practical problems and questions are discussed. Also, every morning one topic from the SOPs, the standard operational procedures, is presented. Martin briefly introduces the main points of one SOP guideline and then opens up to all men for discussion. Continual learning in the group is important. I'm standing at the front side of the room with the team leaders and while I listen to Martin I can feel the eyes of the men on me – a female, white visitor is rare I guess. And so I am relieved when the curious tension gets

---

55 Thanks to my friend Kofi Derrick Amoah for alerting me to this proverb and for translating it for me from Twi.

addressed as Martin introduces me briefly at the end of the morning address. He uses the opportunity to remind the men that there should be "no short-cuts" today, "we have a visitor and she will write about us".

The men stand up and organise themselves in teams, and only a couple of minutes later one pick-up after the other leaves the compound. It is a peculiar image, a fleet of dark blue pick-ups with each 8 men in blue work overalls at the back swarm out to fulfil their daily mission in Obuasi. I leave with Ben, one of the team leaders, in his blue pick-up. The pick-up belongs to the company and on the side of the car it reads 'AngloGold Ashanti (AGA) Community Malaria Control Programme Obuasi'. On the back of the car sits half of Ben's team, 8 men in blue overalls, the second pick-up with the rest of the team drives in front of us. We drive 10 minutes into central Obuasi and begin the working day. Here, Ben is also doing a quick morning brief, reminds his men to do "quality work" and then the team spreads out into the settlement. It is always two men going together, one is responsible for the preparation of the rooms, he asks the inhabitants of the houses for entry permission, covers the furniture and belongings of people with white sheets, and fills in a little statistical form recording the numbers and gender of the inhabitants, children under 5 and 1 year of age, as well as the number of sprayed structures. The second person in the team is mostly unrecognisable: He not only wears his blue overall but also a helmet and protective mask over his face. The spraying pump hanging over the shoulder does not help taking away the scary impression[56].

---

[56] The to me 'scary impression' might well be due to my lack of experience with living in Ghana. As an anthropologist working in Ghana alerted me, insecticide spraying and the protective clothing can also be seen on the many cocoa plantations in Ghana, and might thus be a much more familiar sight for many Ghanians than for myself.

Figure 9: Sprayer in action in Agogo

Never the less, according to the Malaria Control Centre in Obuasi, insecticide spraying against malaria is widely accepted; 95% of the household agree to the activity. The indoor residual spraying (IRS) project that this chapter discusses is a Corporate Social Responsibility (CSR) project of the gold-mining company AngloGold Ashanti (AGA). AGA is one of the biggest gold-mining companies worldwide, and Obuasi the oldest commercial gold mine in Ghana. With insecticide spraying the project relies on a malaria control intervention with a long and complex history (see *Chapter 3*). In short, after insecticide spraying had lost popularity in the 1970s, the WHO brought spraying back on the worldwide malaria control agenda in 2006 (WHO, 2006), mainly as a reaction to a rise in malaria cases. Since then insecticide spraying is again part of the global public health strategy of the WHO.

However, 2006 was not only the year of the official policy change, but also the year spraying started in Obuasi. The malaria control project had already started in late 2004, but spraying kicked only off in 2006. This chapter is the result of two ethnographic visits to the insecticide spraying project in Obuasi. The following sections introduce the malaria control centre and project in general (*Section 3.2*), explain the technique of spraying and the operational side (*Section 3.3*), the entomological component of the project (*Section 3.4*), as well as its community engagement activities (*Section 3.5*). In *Section 3.6* I discuss and analyse the different components of the project, and relate the science and ecology of insecticide spraying to the project's public engagement strategy. Instead of seeing the project as a public health intervention, I propose to understand it as a real-world experiment, and discuss some consequences of such a re-conceptualisation for public engagement processes in malaria control. Finally, *Section 3.7* outlines the development of the project past my visit in 2008, and shows how this corporate malaria control project will be extended over a large geographical area in Ghana over the coming years.

3.2 The Malaria Control Centre in Obuasi

AGA's malaria control centre was opened in an official ceremony with the (at the time) President of Ghana, John Agyekum Kufuor, in attendance. At the event the President named the sprayers "blue warriors" – a term referring to both the blue overalls of the men and their mission: the fight against malaria. Steve, the manager of the program likes the term and smilingly adds that the team even built a flag stand in front of the main building for him - a signpost to Steve's former career in the South African military. Steve is an experienced malaria fighter, he has already worked in malaria control in Mozambique. The entomologist of the project also comments on Steve's former profession and adds "you know lots of malaria control was done by the military, the Panama Canal and so on. It's all military stuff".

Indeed, from my two short visits to the project I also get the impression that the project is located somewhere between a military intervention and an accurately planned scientific experiment. But more about the specifics of the project in the next section. For now, let me briefly inform you about the track record of the project so far. The project concentrates on vector control, but encompasses the following four key elements: vector control (including IRS, larviciding, ITNs), surveillance and monitoring, improved disease management (diagnosis and treatment) as well as information, education, communication (IEC) and health promotion.

Within vector control, the biggest part of the project is dedicated to 'indoor residual spraying' (IRS). The WHO defines:

> Indoor residual spraying normally refers to the spraying of all stable surfaces inside human habitation using an insecticide with residual action. (...) The expected result of indoor residual spraying is mainly the reduce the survival of vector(s) entering houses, whereas antilarval measures are aimed at reducing vector density. When indoor surfaces have been sprayed with residual contact insecticides, mosquitoes die when they enter and rest in those houses. (WHO, 2006: 1-2)

The project has been hugely successful in reducing malaria rates in Obuasi, and has become well-known nationwide (if not internationally) for its success: already in its first two years of operation it has reduced malaria incidence by 73% (AGA 2007:14). And the impressive reduction in malaria cases that the project can record is mainly due to the four rounds of IRS from 2006-2007:

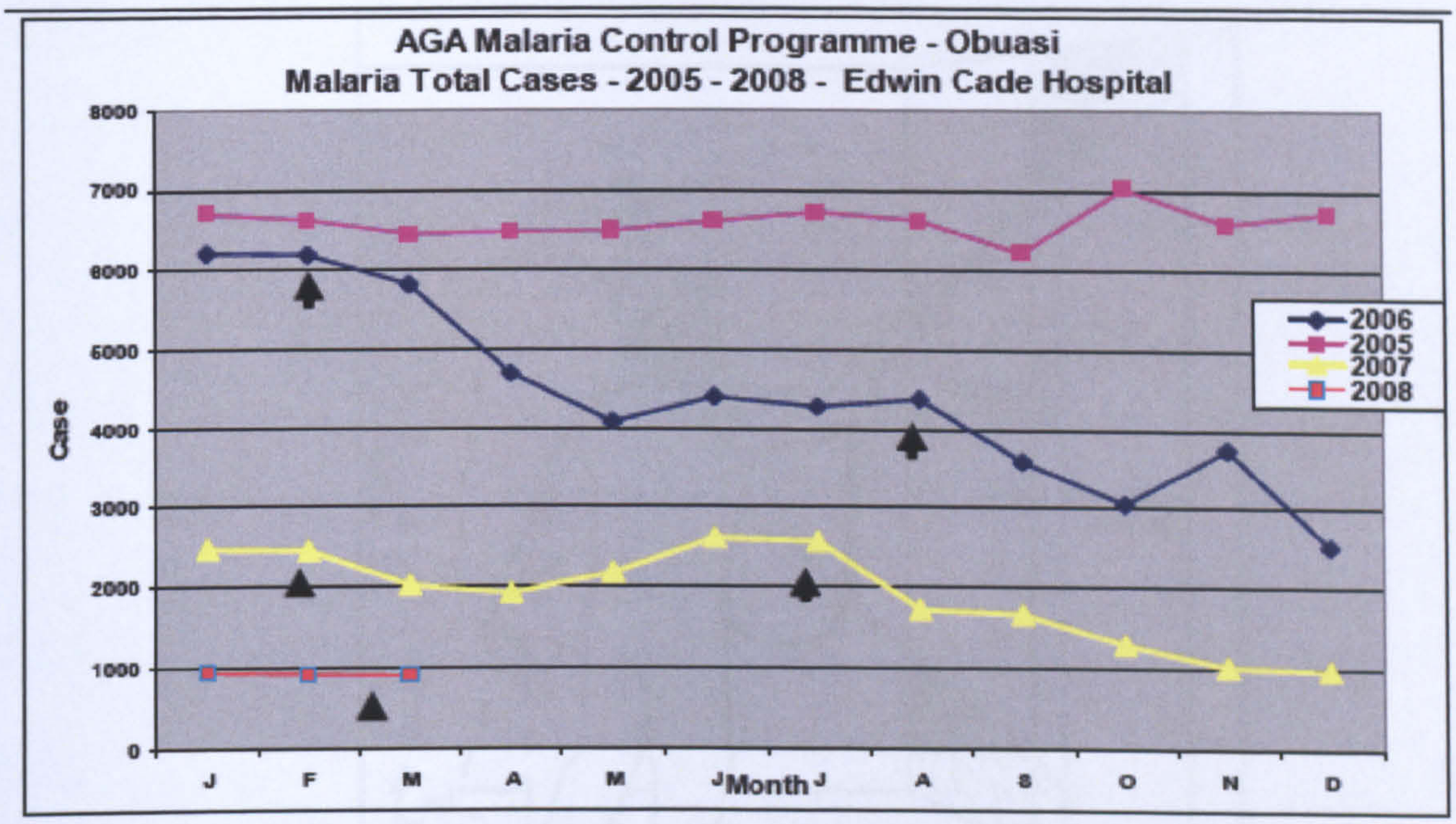


Figure 10: Malaria Cases, Obuasi 2005-2008 (GFATM, 2008: 52)

The Edwin Cade Hospital is a mine-owned hospital, but because of the good quality of care the most frequented hospital/health centre in Obuasi. The numbers are thus quite representative of Obuasi. But before thinking more about the project itself and its success, let's first see how the spraying project is actually *done* or conducted.

3.3 "Spraying is like music" – the organisation of IRS in Obuasi

While reading the foregoing section one might have asked oneself what insecticide spraying actually looks like. "It's like music", says Enoch, the project's entomologist to me, "you need to maintain a rhythm". He gets up from his office chair and shows me some of the basics of spraying technique – "it is important that one always maintains the same distance to the wall with the spray head. If not, the insecticide would be unequally distributed over the wall, and we don't want that. So, you have to mark a curve with your arm, starting off close to the wall with your hand close to the top of the wall and then do an outward bending curve".

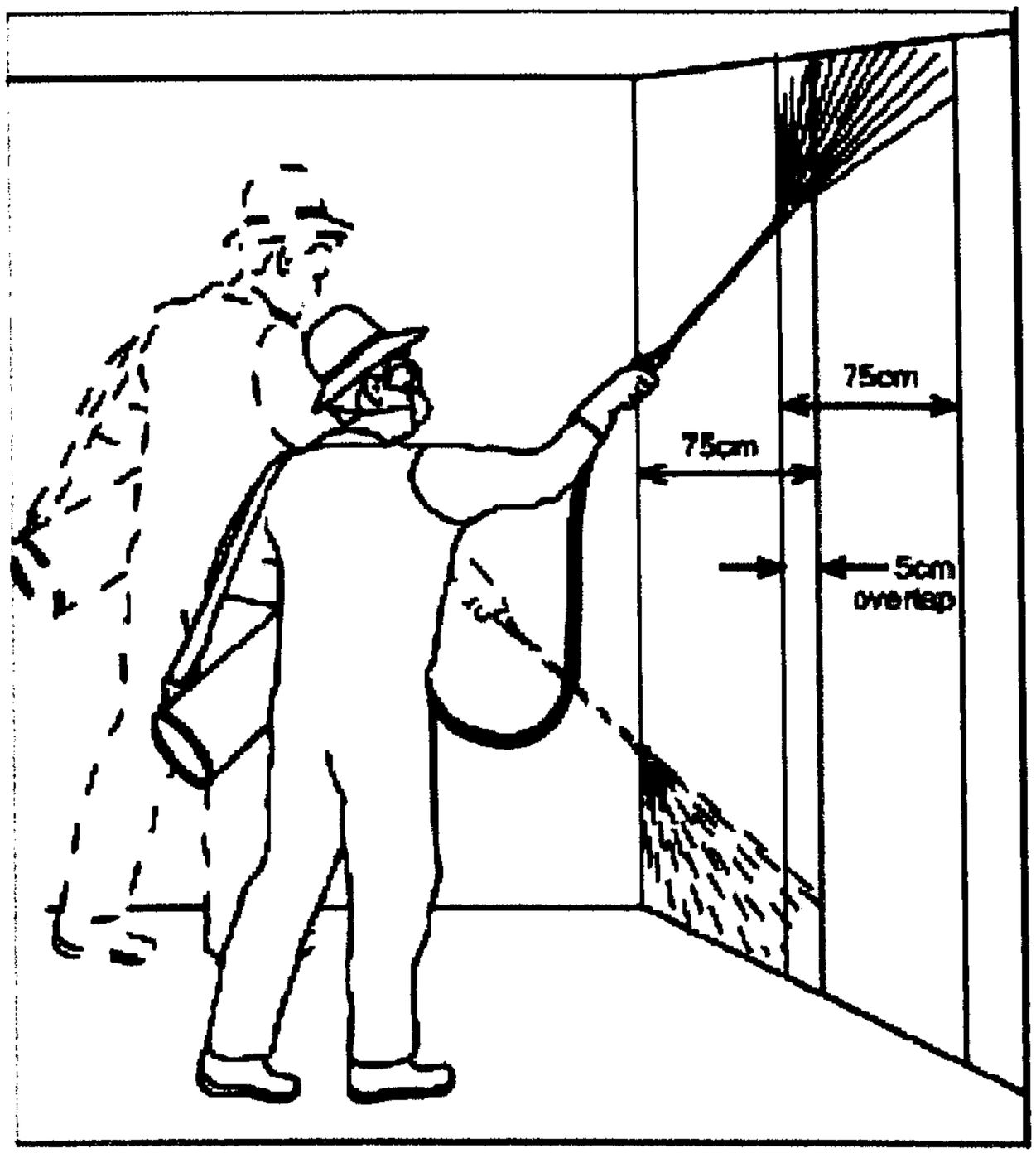


Figure 11: Spraying technique (WHO IRS Manual, 2000)

But distance is not the only element of the choreography as I learn later when I watch the spray men perform their daily work. One also needs to keep the pace; the curved movement is done in one smooth flow. The finish, however, is quick, there should not be hesitation when one reaches the floor, one needs to pull away the spray head quickly, if not insecticide is spilled on the floor. And before one begins the spraying one should not forget his prayer. This is of course a joke. A joke I learn from the spray men, but indeed the prayer should not be forgotten. What the men refer to as 'prayer' is the shaking of the bottle so that the insecticide suspension is mixed properly before spraying. It indeed looks like a quick prayer when one observes the men: the spraying pump hanging over the shoulder, the men briefly bend down towards the wall, thereby shaking the bottle, and then in one movement raise their arm and begin the spraying curve.

And after I learn all this, the –at first quite strange sounding– comparison with music makes sense; spraying is a skill that requires precision, and indeed, a calm and concentrated rhythm. This requires training and here the AGA malaria control project does not compromise. Behind the buildings of the Malaria Control Centre Steve, the project manager, shows me a wall, "here is the wall of pain", he jokes, "this is where we practise the spraying". Before every round of spraying –once every six months– the men have to undergo a refresher course, where the technique gets practised again.

The logistical organisation of the spraying is equally meticulous. The spray men are organised in two-men-teams, and those two-men-teams then belong to 16-men-teams for each designated area. Each 16-men-unit has a team leader, who coordinates and supervises the spraying as well as distributes spraying notices that households get one day before the spraying. The team leaders in turn are supervised by an operations manager, who coordinates the different spraying units. Overall, the whole centre is organised in way of a hierarchical pyramid of staff and responsibilities. The headquarters of operations is centred around a big table with an aerial photograph of Obuasi. With the help of this Obuasi gets divided into spraying units, which then are allocated to the different teams and project weeks[57].

All sprayers are employees of the company, however only on temporary contracts. Each spraying cycle takes 5 months, followed by a break of 1-2 months. The workers are not employed in the break. In practice most sprayers get reemployed for the next spraying cycle, however due to the temporary contracts the company is not required to do so. This puts the employees in a precarious position, and as one of the sprayers, Yaw, told me makes it difficult to express criticism and demand for workers rights. For instance, Yaw fears

57 More on the role of aerial photographs and participatory mapping in malaria control in Dongus et al, (2009).

that carrying the heavy insecticide pump on the shoulder everyday might one day have health consequences for him. Because of the short contracts, however, he does not feel able to 'speak out' on this issue. Yaw fears that if he did, he would simply not be employed again for the next round of spraying.

However, not only the logistics of the project are accurately planned, the scientific component of the project is impressive too. This is in fact the first sentence I noted down in my field diary on my first day at the centre: “Wow, this was an impressive day!”. The project is impressive in many ways. Firstly, probably because one would not expect a fully-equipped entomology laboratory on the premises of a gold-mining company. Neither did I expect a full-time entomologist working there. In fact, Enoch, the entomolgist, is a PhD student, but what a PhD student: he is not only the head of lab and insectary, he also coordinates 18 members of staff, who are employed for the mosquito collection that happens every second night. Often, Enoch himself goes with the team, and spends his night either inside the home of one of the inhabitants in Obuasi, or in front of the house catching mosquitoes.

The thorough training, up-to-date entomological science and meticulous operations already describe much of the ethos of the project in general – things get done properly in Obuasi. But there is also an enormous amount of dedication and curiosity flowing into the project – to an extent that sometimes the work seems to become detective work. For instance, at one point in 2006 there was an unexpected but significant peak in malaria cases, the curve of malaria infections that so nicely went down suddenly peaked again. Nobody knew why, Steve recounts the team's search for the 'why' captivatingly: “We went into the clinic and asked people for possible explanations' but nothing seemed to fit, there were neither school holidays (bringing children and parasites back from boarding schools in other regions in

Ghana), nor was there a significant period of rain, and it was also not the holiday period of the statistician (which has lead to irregularities in the reported numbers before)".

The team was perplexed by this until someone came up with the unlikely explanation: Exactly 13 days before the peak occurred, there was a funeral in Kumasi. It was the funeral of an important former mine employee and the company had organised buses to bring people from Obuasi to the funeral in the regional capital, one hour drive away from the sprayed area in Obuasi. Funerals are important in Ghana, stretch over several days, include night time activities and usually happen outdoors. And this funeral in Kumasi is the place, where all of the people, who 13 days later reported with fever to the hospital, had spent their weekend. While the people were mourning their former colleague, the malaria parasite sneaked into their bodies, and made so many of the attendees sick that it turned up as a clearly visible peak in the malaria centre's monitoring curve.

This story brings crucial features of the malaria control programme to light, it points to both the importance of locality to the success of spraying initiatives, as well as to the investigative qualities of the team. The project is not only logistically well organised and scientifically sound, it also exhibits one more characteristic of successful science: creative and dedicated thinking. However, there is another constituency that makes the project challenging for the team in Obuasi: mosquitoes. The next section will be concerned with those little creatures, and describes the team's efforts at mapping, monitoring and controlling mosquitoes.

5.4 Encountering mosquitoes in Obuasi – the entomology of IRS

Indoor residual spraying aims at diminishing the local mosquito population to a degree that will significantly hamper the transmission of malaria. However, reducing a mosquito

population is not an easy task. This is the sketch of the mosquito map of Obuasi I made while talking to the entomologist Enoch:

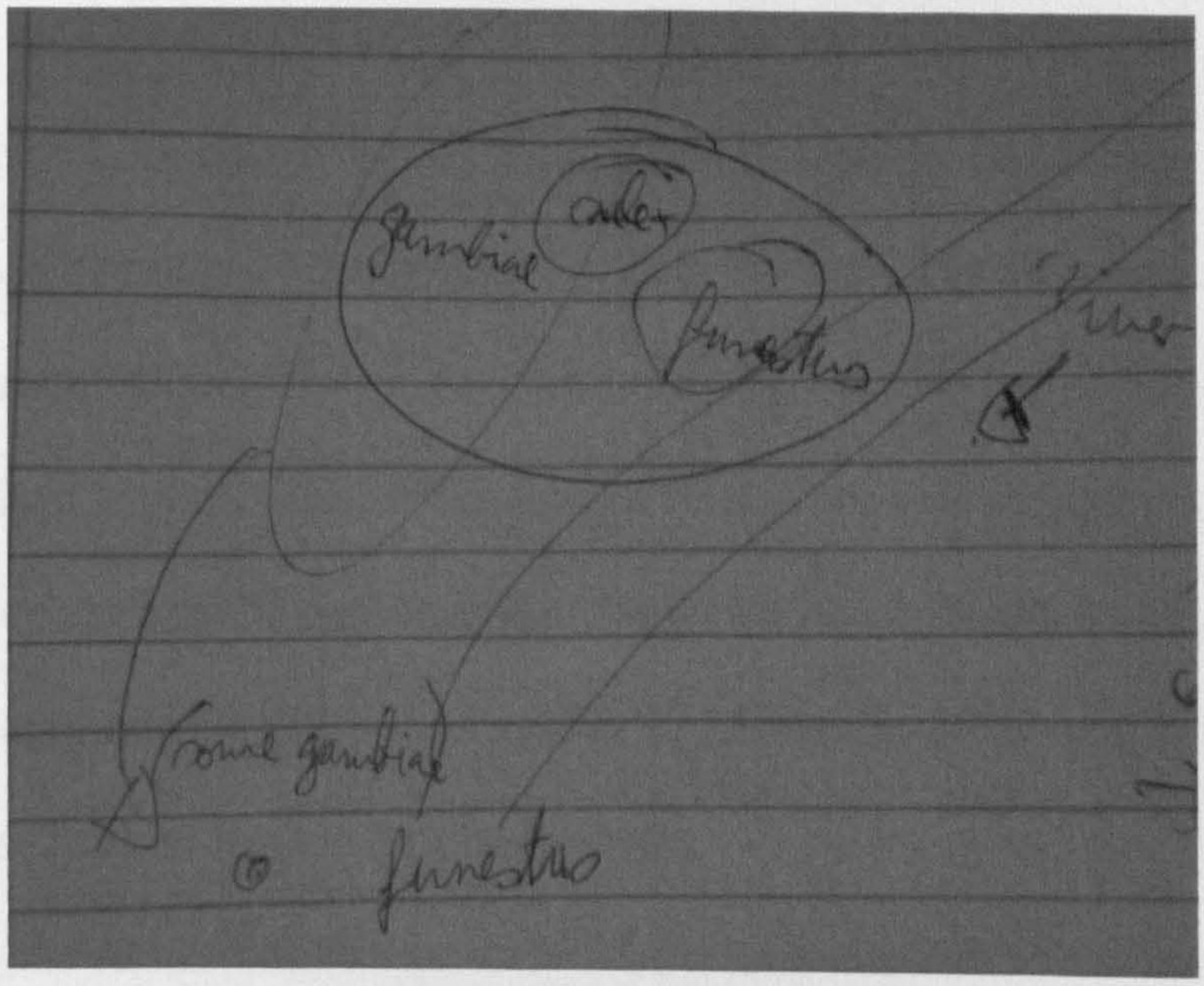


Figure 12: Sketch of Mosquito Map

Obviously, Enoch's map would be far more sophisticated, but what we can see from this map already is that there are clusters of different mosquito species in Obuasi. There are *Culex* mosquitoes, which do not transmit malaria and I often hear termed 'nuisance mosquitoes'[58]. And then there are two species on my map that can transmit malaria: *Anopheles gambiae* and *funestus*.

Currently, worldwide 430 species of *Anopheles* mosquitoes are known, of which around 70 are malaria vectors (Service and Townson, 2002: 59). But, as we heard in the *Introduction* already, there are in fact more, as counting species in malaria transmission is a complex task. It has been first discovered in the 1920s in Italy that most anopheles species are not single mosquito species, the name for one species in fact often refers to a complex of

[58] It is, however, not true that *Culex* are only 'nuisance' mosquitoes, they transmit several diseases such as West Nile virus, filariasis, Japanese encephalitis, St. Louis encephalitis and avian malaria.

species that are morphologically identical, but display differences in genome and behavioural traits (Hackett, 1937). So, one so-called *complex* of mosquito species consists of different sub-species that are reproductively not connected to each other.

This is true for both *A.gambiae* and *A.funestus*. *Anopheles gambiae complex* for instance is believed to encompass six species (Curtis et al., 1998; Mattingly, 1997). *A.gambiae complex* are recognised as the most efficient vector for malaria. *A.gambiae* and A.*funestus* are seen as the two most prevalent malaria vectors in Africa. And even though they are assumed to be the most important vectors in Obuasi too, there are more anopheles species transmitting malaria in Obuasi, for instance in 2004 Coetzee et al (2006) found four species in Obuasi: two forms of A.*gambiae*, *A.funestus* and *A.pharoensis*.

The different species can be distinguished with regards to differences in breeding place preference, exo/endophagic behaviour (out/indoor biting), exo/endophily (resting out/indoors after biting), anthropo/zoophily (prefering human/animal blood) as well as preferred biting times. From Enoch for instance I learn that *A.gambiae* prefer to breed in small collections of shallow, clear water, *A.funestus* in contrast generally choose deep, clear water, while *Culex* mosquitoes can be found near dirty water and in choked drains. Thus, the different species cluster around different ecological sites in Obuasi – even on my sketchy map one can see that for instance *A.funestus* in Obuasi cluster along the river.

And such differences matter when it comes to vector control. For instance exophily would render mosquito nets as well as indoor residual spraying inefficient and genetic differences in different species determine resistances to insecticides. A resistance mechanism first occurs in one species, i.e. genetically isolated population, so in order to plan effective control interventions, one needs to have at least an idea about the different mosquito

populations in the given locality, as well as track their development. Especially so because these characteristics are not stable; mosquito populations evolve quickly. One female *Anopheles* mosquito in the tropics lives approximately 10-14 days and lays 50-200 eggs per oviposition, which usually happens at night (Service and Townson, 2002). If one interferes in the habitat in some ways, the ecological dis/advantages and niches of the different species change and most likely also the population structures will change. Possible adaptations to indoor residual spraying do not only include changes in the genome of species, but furthermore a reduction of exophagic populations could provide endophagic populations with a bigger ecological niche and so provide a survival advantage, ultimately enabling a different species to proliferate.

As we have seen in *Chapter 3 and 4,* insecticide resistance is a major challenge for IRS, and the Obuasi project responds to this with rigorous scientific "surveillance, monitoring and research" (AGA, 2007) of the mosquito population and adapts its intervention strategy accordingly. The project uses rotating insecticides, regular larviciding and additionally removes found larvae by hand. Potential resistance is also why a scientific component, or more specifically an entomological component, has such a prominent place in an intervention-focused corporate social responsibility project on malaria control. The project maintains nine sentinel sites, plus three control sites outside the sprayed area. Every second night, two men per site expose their naked legs and function as 'human landing catches'[59], attracting mosquitoes to their leg and then carefully collect the caught mosquitoes in cups. The cups are ordered in hourly progression, in order to determine exactly how many mosquitoes got caught at which hour. This enables the entomologists to reconstruct a biting cycle. The caught mosquitoes are transported to the insectary, where

---

59 As macabre as this might sound to the ears of social scientists, but the 'human landing catch' is an entomological technique for collecting mosquitoes, in fact it is a technology that proves more effective than the more technology savvy 'odour-baited entry trap' (Dia et al., 2005). One (rare) instance where humans prove to be superior to machines.

they are counted, analysed for insecticide resistance, and finally frozen in one of the massive fridges there for future reference.

In addition, Enoch maintains a live mosquito colony and with those mosquitoes conducts bioassays every month. This means the team puts 15-25 mosquitoes in one cone that is attached to a sprayed wall and assesses the 'knock-down rates', i.e. counts how many mosquitoes die after how many minutes. This proves the continuing effectivity of an insecticide, or alerts the team to emerging resistance quickly. All these labour intensive activities make Enoch intimately familiar with the mosquito population of Obuasi; he knows which species of mosquitoes live where, in which densities, how these populations developed over time and if resistances arise and where. But Enoch is not only concerned with mosquitoes, he also monitors parasites. The team takes blood samples from Obuasi's human population, both from within the sprayed community and outside. And the results sometimes even shock Enoch: outside of Obuasi the malaria parasite prevalence has been as high as 50% in random checks of non-ill people[60]. The results of these analyses then fed directly into decisions about insecticide selection, larviciding and the intervention strategy more generally. Such a research-based approach is important to the ethos of the project, a constant movement between data from the field, lab experiments and a adaptable intervention strategy is necessary to register and counteract arising resistance quickly. And so being sensitive to the local specifics of the mosquito and parasite population becomes crucial to the success of a malaria control intervention in the age of resistance. Steve, the project manager, underlines the importance of being familiar with the locality, or field of the intervention: “Some organisations bring in 'experts' who don't know what's happening. You have to be here and be patient to see and understand. I have got time, I'm in no rush”.

---

60 These high prevalence rates of parasites in non-ill people are characteristic for stable high transmission areas, people and parasites co-habit (see also Owusu-Agyei et al, 2009). However, the resilience of people to those parasites in their blood does not come naturally, the communities 'pay a high price' as one entomologist in Ghana points out to me, and this price are deaths in non-immune children, the ones that do survive deal fairly well with the co-habitation, but this is far from everyone.

5.5 "Often it's enough to educate people" – community involvement in IRS

Besides spraying and entomology, the project has a third component: community liaison. The community liaison officer is an apt appointment, as a Northerner –from the disadvantaged and predominantly Muslim part of Ghana– Rachid can connect well with the least well off in Obuasi. Like many, he was a farmer in Obuasi himself, and got offered work at AGA as a compensation mechanism when the company needed his land for gold-mining purposes. Later, Rachid got transferred to the community malaria program.

Rachid now has four members of staff who, as he says, 'go after' the spray men. So, if the sprayers do not find people in a house or if people refuse to get their houses sprayed, Rachid's men go and check. "Often", Rachid says, "it is enough to educate people on where malaria comes from and inform them about the symptoms. Mostly, people don't think it is caused by mosquitoes if someone dies early, it is believed to be witchcraft. When people learn, they often let the spray men spray", he says.

Rachid also organises local committees in the Obuasi municipality. The committees are chaired by the traditional authority, the Chief[61] of the area, and include two assistants to the Chief (who are also opinion leaders of some sort), the assemblyman, the women representative of the area, a youth leader and an ethnic minority representative. Two people of each committee act as 'community advocates'. In preparation for this they take part in a seminar on the causes, symptoms and treatment options of malaria; after this they act as contact person between the community and the project.

61 'Chiefs' are the traditional authorities in (a majority of) Ghana, and remain very influential in Ghanaian society. It is important that a development or scientific project/initiative is approved by the local Chief.

Furthermore, the project has bought airtime at the local radio station 'shaft fm'; they are 'on air' twice a week, discuss the project and answer questions. The union has also reserved a spot in their weekly meetings with the company for the malaria initiative, and Rachid and his team furthermore go along to social gatherings, visit schools, churches and mosques in order to connect with the people there and just "chip in our programme in 5 minutes". Rachid and his team do a great job and – with 95% of houses sprayed – the community relations seem to be working well. However, what also helps are the subtleties of public advertisement.

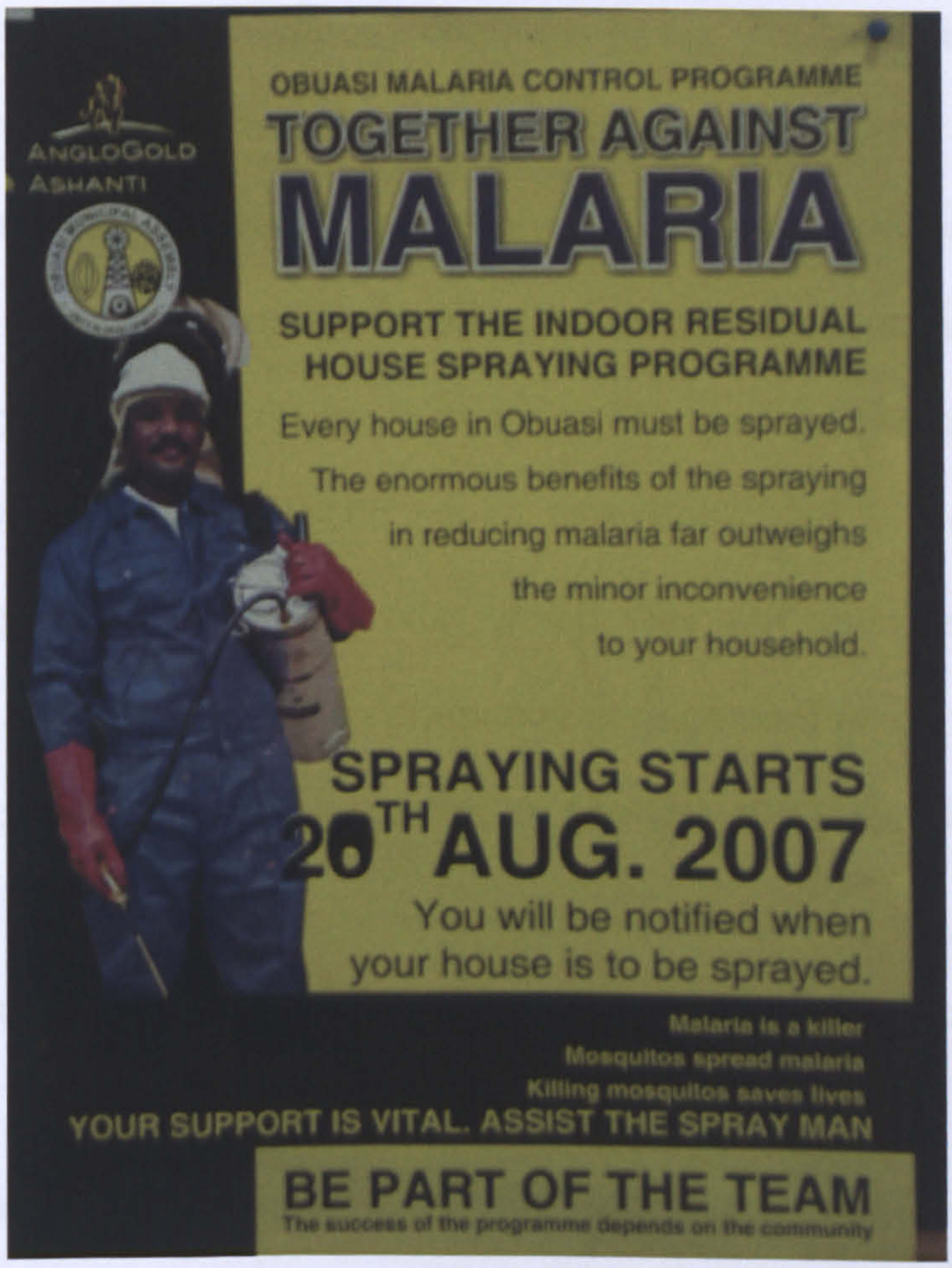


Figure 13: Anglo Gold Ashanti Campaign Poster, 2007

These are the posters that announce the spraying. The sentence 'Every house in Obuasi must be sprayed' is to be noted. Of course, not every house in Obuasi must be sprayed.

The company can (and does) require residents of company-owned houses to allow the spraying, but has no power over private housing in the municipality. But the sentence plays with the fact that (a) people might not know this, and (b) that people might not feel able to resist the overwhelming power of AGA in the city.

This poster could be read as a subtle coercion mechanism. However, the public engagement process of the project cannot justifiably be reduced to this sentence as Rachid's team is in constant dialogue with the community. For instance, people tell me that one of the first insecticides that got used left a bad smell in the houses for days. People complained about this through various channels to the Obuasi malaria control programme, and as a result the project changed the insecticide. Thus, the team is open for engagement and criticism. However, the overall strategy of the intervention got designed without the public, and a big part of the strategy focuses on education about malaria and on convincing people that this project and strategy is needed. The general assumption is that people do not understand the correct scientific cause of malaria and just need to be exposed to 'behaviour change communication', after which they will endorse the project. While the foregoing section has discussed the community engagement practices of the malaria project in Obuasi, the next section will now provide an analysis of the overall project.

5.6 Malaria control as a real-world experiment: spraying, science and public engagement

The trope that people don't understand what is at stake in science is familiar. Since the 1980s the relations between science and society have received considerable attention in US-European debates, both in the public sphere and academia. For instance, scientific innovations such as nuclear energy or genetically modified organisms have been subject of intense public debate. In many cases citizens' protest was understood to be the result of

citizens "misunderstanding science". This approach to science-society relations was termed "deficit model" since it assumes the public to be ignorant about science, to have a knowledge deficit.

However, it has been shown that a division between rational experts and an emotional public is not convincing (Wynne, 1996), and an educational approach to public engagement with science not only often misses the public's concerns, but is an "*un*-productive and even *counter*-productive" way to frame the debate (Irwin and Wynne, 1996: 219). This is not to be read as a dismissal of science and its importance, but highlights problems emerging from an unquestioned authority of science: "to accept science as a key resource in public issues is radically different from accepting its automatic authority in *framing* what the issues are" (ibid: 8-9). Irwin and Wynne argue that science needs to engage with "its own epistemological limitations" and open the debate up to different onto-epistemic framings and positionings (ibid: 219).

As a consequence, several experiments on how to best involve citizens in science policy recently took place in the UK[62]. While results were generally mixed and brought to light paradoxes and problems of a public participation paradigm (for instance Cook and Kothari, 2001; Singh, 2008), they arguably succeeded in destabilising the primacy of scientific knowledge in societal decision making. Bringing this debate together with anthropological research on "Science and Citizens" in developing countries Leach, Scoones and Wynne (2005) point out:

> In both developing and developed societies contexts, therefore, it has been accepted, at least in principle, that science can gain democratic public legitimacy

62 Most prominent was probably the government-initiated "GM Nation?" (2003) debate or initiatives like the "Nanojury" (2005), supported by Greenpeace, The Guardian, Cambridge and Newcastle University.

> only if it recognises its own need to understand itself in relation to these other cultures, and to learn respectfully to negotiate with and to accommodate to them, rather than dismiss them as vacuous, untrustworthy and emotive. (Leach et al, 2005:9)

Public engagement processes with science as well as citizens' protest could also be understood as a reaction to what Krohn and Weyer characterise as an "experimental society", arguing that science increasingly conducts "real-world experiments" (Krohn and Weyer, 1994) or –in the words of Szerszynski– that the world has become a "laboratory without walls" (Szerszynski, 2005). The authors argue that experiments are not taking place in a "carefully isolated space" anymore; the boundary between experiment and world gets dissolved (ibid.). To these authors the development of new technologies, particularily genetic modification, and their trials and release in the world has moved science increasingly from the laboratory into the world as a space of experimentation. The notion "real-world experiment" has been coined in order to capture this spatial shift and its societal implications in experimentation. But can the spraying project in Obuasi be conceived as such a "real-world experiment"?

I argue the Ghanaian spraying initiative can be understood as a "real-world experiment", because, as we have seen in the foregoing sections, IRS in the age of insecticide resistance cannot be reduced to the application of a proven strategy, but requires constant monitoring, surveillance and adaptation. The project's strategies have to be put to the field-test continuously, and this adds an experimental character: reaction and development of mosquitoes are observed, and the intervention strategies are modified and adapted accordingly. Through this knowledge moves between laboratory and field, and between mosquitoes and scientists.

However, while I agree that this movement adds an experimental character to the project, I do not follow Krohn, Weyer and Szerszynski's assertion that this trend is particularly new. Rather, as Pestre points out, knowledge production has never happened outside of society, but always in constant negotiation with political and social processes (Pestre, 2003). Moreover, Bonneuil in a study on late colonial and postcolonial Africa argues that "after the 1930s, development came to be seen as an experiment, and Africa as a laboratory. This shift from "governing, thanks to the light of science" to "governing as an experimental activity" is an essential feature of the emergence of a development regime in Africa" (Bonneuil, 2000: 281). Equally, ecology as a discipline has emerged through work within a "lab-field border-zone", as Kohler points out: "The boundary between lab and field cannot be demarcated by a line, as political boundaries are drawn; rather it is a zone of mixed practices and ambiguous identities (as are also boundaries between disciplines)" (ibid, 2002: 18).

Thus, Krohn and Weyer's diagnosis of an "experimental society" has to be seen as an integral feature of science rather than a new process. Nevertheless, the concept of a "real-world experiment" enables us to distinguish between science mainly performed in the laboratory and scientific practices that move between laboratory and field for knowledge production. While malaria control has always required a movement between lab and field, insecticide resistance has exaggerated this trend. Resistance has not only made the intervention intimately connected with scientific studies, but has also necessitated a constant movement from lab to field, and from field to lab. As Latour in *The Pasteurization of France* (1988) has shown successful science moves between the lab and the world in various ways, and this ability to navigate such translation processes successfully

characterises good science (ibid; Latour, 1999). Moreoever, it is this movement that enables scientists to make claims about the world:

> What they (the Pasteurians) did is much more interesting than what they are credited for. Their "contribution", if we insist on this term, is to be found in a certain style of *movement that was to allow them to connect "diseases" with the "laboratory"*. They were to succeed by moving disease on to the terrain of the laboratory where they, the Pasteurians, had the upper hand. (Latour, 1988: 62, emphasis added)

Thus, it is the movement between the world, the object of inquiry and the laboratory that is important in order to establish a 'scientific fact'. Lezaun and Millo (2006) in their analysis on "regulatory experiments" qualify this further by pointing out that "experiments are constituted by two parallel and apparently conflicting moves: one of separation, or distancing, the other of bridging or projection (...) Yet projection is not simply a matter of judging, let alone of inscribing the conditions of generalizability into the experimental design, but of continuously adjusting and readjusting the experiment and the world at large" (2006: 180/182). Similarly, for insecticide spraying there is no final victory –as there was in the "war between humans and microbes" for Latour– but rather *constant movement*. In the Obuasi project, knowledge continuously moves between laboratory and field – between mosquitoes, which are manoeuvring their world; and scientists, who are creating knowledge about how humans might best manoeuvre the world.

More precisely, I would like to suggest that the IRS project consists of two distinct movements: it moves between lab and field studies, as well as between scientific experiment and public health intervention. Let me stay with the first movement for a bit.

Following Kohler (2002), Obuasi could be characterised as a "labscape": "the active site of a cultural borderland, where laboratory and field practices can meet and mingle" (ibid: 51). Kohler argues that until the field sciences had standardly incorporated many practices from the theoretico-experimental laboratory-based sciences, "instability and movement were the common experience of those who aspired to bring experiment to the field (...) the lab-field border was a place of things and people in motion, a mosaic of varied practices, a shifty, patchy place – like nature itself" (ibid:137).

Importantly though, mixing experimental and field practices changes the relationship between science, its research objects and the public, or –to put it differently– it modifies the definition of research "subject and object" (Stengers, 2000: 130ff). As Szerszynski (2005) has shown in his analysis of field trials with genetically modified crops: "In the laboratory without walls each 'datum' is also potentially a real-world risk event, bleeding out from the experimental context into wider society, so too do societal actions present themselves as data, as findings" (ibid: 192). Szerszynski argues that all public acts relating to a field trial are part of the experiment, including for instance people, who destroy fields in protest[63]. To him this indicates a need to rethink the ethics of engaging the public in real-world experiments. Public engagement processes would need to acknowledge the experimental character of their intervention and give space for people to engage actively. Leach, Scoones and Wynne portray such approaches as follows:

[63] Bonneuil et al (2008) pursue a slightly different argument than Szerzynski in their analysis of GM field trial contestation in France. They also portray the boundaries between science and society as shifting and subject to boundary work. For them this is not a novel process, but rather historically grown. In their analysis they proceed to concentrate on the actors in different arenas and their interaction. They argue the (successful) contestation of GMOs in France was the result of "interactions between actors in diverse arenas characterized by specific grammars" (226). However, what is lost in their analysis is an understanding of the public as it emerges from the practices of the experiment itself. To Bonneuil et al. the experiment remains an object that creates contestation but does not define the public in return. Szerzynski's analysis, however, draws attention to the mutual constitution of experiment and public.

Mainstream approaches to 'citizen involvement' with science and technology have been based on implicit models of the citizen grounded in versions of liberal theory. In these, citizens are either expected to engage passively with expert scientific institutions, especially those linked to the state, or to participate in forums orchestrated by such institutions. This contrasts with a model of the citizen as a more autonomous creator and bearer of knowledges located in particular practices, subjectivities and identities, who engages in more active ways with the politicised institutions of science. (...) Although sometimes implicitly, these developments reflect a recognition that knowledge, including scientific knowledge, as deployed in public arenas, is inalienably cultural, in that it embodies, reflects and projects commitments of a human kind, which also shape human relations and identities, imagined communities and ontologies. (ibid, 2005: 12-13)

The IRS project discussed in this chapter pushes such arguments further by inviting us to integrate the shifting nature of ecology into the equation. What happens to our notion of public engagement if we understand IRS as a real-world experiment rather than a public health intervention as it is generally conceived in malaria control? As we have seen above, IRS in the age of insecticide resistance cannot be reduced to the application of a proven strategy, but requires constant monitoring, surveillance and adaptation. The project's strategies have to be put to the field-test continuously. Such practices make one feature of the field sciences visible that is carefully shut out in research solely based on laboratory techniques, namely "irreducible uncertainty" (Stengers 2000:144/45). The specifics of place complicate the field sciences: "what one terrain allows us to affirm, *another terrain can contradict*" (Stengers, 2000: 140).

As a result the boundaries between what is inside and outside of an experiment are more difficult to maintain. Accordingly, Szerzynski argues, we have to understand 'outsiders' as 'insiders' in real-world experiments. To him people, who protest against a field experiment, are not intruding but belong to the experiment, they are a form of "data" (Szerzynski, 2005: 192). Stengers would probably like Szersynski's subversive move, since she also would not want to abolish the distinction between object and subject in experiments completely, but modify "its meaning: it is recognised not as a right, but as a vector of risk, an operator of "decentering". It does not attribute to the subject the right to know an object, but to the object the power (to be constructed) to put the subject to the test" (Stengers, 2000: 133). Thus, Stengers and Szerzynski both argue for an opening up of our understanding of experiments, and for giving more people (and things) the opportunity to 'take part' and define the terms of real-world experiments.

We could say that through monitoring and adaptation mechanisms the IRS project is already designed in a way that expects 'things', in this case mosquitoes, to react to the experiment's intervention. However, this would presumably not satisfy Stengers as, at the end of the day, the IRS project still aims at keeping the mosquitoes as silent and passive as possible and keeping them 'object'. The IRS project allows the 'object' to ask questions back, however it does not allow questioning of the overall strategy: What if the all-out, military style war against mosquitoes and parasites is futile? Maybe modifying the conditions of how mosquitoes, parasites and people live together would be more effective than getting lost in a game of attack and counter-strike?

Similarly, the project's public engagement mainly focuses on education and learning. The need to achieve measurable success makes public health education tools such as 'behaviour change communication' a popular choice for IRS public engagement processes –

it literally forms the path of least resistance. The project is herewith firmly anchored within a public health strategy of malaria that focuses on technological interventions, delivered with the help of public information and education. Montgomery et al. characterise the neglect of wide-ranging public engagement and broader socio-cultural context as a "hallmark of public health approaches to malaria" (Montgomery et al, 2010: 4). Public health strategies in malaria control traditionally focus on top-down 'behaviour change communication' (BBC) and 'information, education, communication' (IEC).

However, such techniques were developed for public health interventions that are based on sound and stable health knowledge. As has been shown in *Section 4* of this chapter, no stable facts exist in the age of insecticide resistance. IRS interventions today are real-world experiments, which are always in movement because the behaviour of mosquitoes, parasites and humans cannot be held stable. The 'objects' of the experiment respond in unexpected ways, and this is why monitoring and surveillance need to be an integral part of IRS strategies today. But ecological requirements of malaria control interventions sit potentially uncomfortably with attempts to make democratic decisions about spraying. Especially in stable high transmission areas success of IRS has always been notoriously hard to sustain, because mosquito populations evolve and (re)rise quickly. For instance, the Garki spraying project in 1970s Nigeria was not able to break the malaria transmission cycle with IRS, and it famously watched malaria move quickly back into the sprayed area, only two years after the spraying ceased malaria rates were back at pre-project levels (as discussed in *Chapter 3. 2.4*; Molineaux et al., 1980). The same is true for Sri Lanka's history of malaria, where, the moment spraying stopped, malaria rates rose again quickly. As a consequence, high coverage rates of IRS are necessary in order to reduce the mosquito densities in a locality sufficiently. Kolaczinski et al (2007) explain the ecological dynamics of IRS:

IRS controls malaria by reducing the vectorial capacity of the anopheline vector and thus transmission. Its impact on vectorial capacity is dependent on the resting behaviour of the vector, limited imported malaria and well-timed, high quality, high-coverage implementation. In turn, the impact of any reduction in vectorial capacity on malaria prevalence is dependent on the baseline level of transmission (Macdonald, 1957). Even a moderate reduction from low baseline transmission can dramatically reduce prevalence, making interruption possible. At high baseline transmission, a proportionally greater reduction is needed to achieve a significant reduction in prevalence, making it unlikely that interruption can be achieved. (ibid: 852)

Furthermore, mosquito populations reproduce quickly; one mosquito lays 20-500 eggs per oviposition (usually every 2-3 days), meaning that under biologically favourable conditions, the population curve can rise from 1% to 100% again in a few months. And this is why many argue that a high coverage of IRS is needed in order to diminish the mosquito populations sufficiently. If coverage is only partial, spraying will be likely to reduce the mosquito density in covered places, but the overall effect in the bigger area (such as in a municipality like Obuasi) would remain small. Secondly, if IRS coverage is patchy the likelihood that one only repels the mosquitoes to areas with no IRS coverage, or where people refused the spraying is high[64].

It is unclear, however, if high coverage rates would be achievable when a thorough public education and deliberation process is conducted before the intervention. In this context it is important to recall the contested history of insecticide spraying in the 1960s, which was

---

64 However the effects and pathways of repellency are scientifically less clear and recent studies in Tanzania are only now starting to investigate these dynamics more thoroughly (Killeen et al, 2010).

characterised by one of the first worldwide and high-profile environmental controversies, triggered through the book 'Silent Spring' by Rachel Carson (1962). Ultimately the campaign led to the ban of DDT in most UN countries (US EPA, 1972; Ghana EPA 2006). Furthermore, comparatively high costs of spraying make it questionable that –after a thorough public deliberation process– IRS would achieve coverage rates of 80%.

Presently, top-down public health education tools such as 'behaviour change communication' are the standard choice for IRS public engagement processes. Very much like it is applied in the project in Obuasi, public health eduction aims at educating and informing the public about the project and its (beneficial) effects in order to increase acceptance. Engagement here does not mean that the public has a say in the *how* questions of spraying or malaria control more broadly. And usually behaviour change communication ensures high coverage rates for IRS. However, as has been pointed out above, such techniques were developed for public health interventions that are based on sound and stable health knowledge. The process is based on the assumption that the intervention is proven to be beneficial to the public. And herewith we are at the second border-crossing of the IRS project: It is at the same time a scientific experiment and a public health intervention. As I have discussed above, there are no stable facts in the age of insecticide resistance. IRS interventions are real-world experiments, which are always in movement because the behaviour of mosquitoes, parasites and humans is not stable either – it is a constant game of intervention and response. This makes success and failure more elusive than before, and while malaria cases will decrease through spraying, it is more questionable if this reduction will be sustainable.

Thus, I argue that a public health strategy of 'behaviour change communication' is inadequate, because it neither relates to the changing ecological realities of IRS, nor takes

into account risks that might be associated with long-term insecticide exposure (Sereda et al., 2009; US Dep. of Health, 2002), or the broader possible consequences of wide-spread insecticide resistance[65]. Such a strategy does not account for the continuous movement between field and lab in the intervention. Thus, I would like to suggest that the public engagement strategy of IRS would benefit from relating differently to citizens affected by spraying. Instead of focusing on behaviour change education, the project could understand IRS as a real-world experiment with more than one active experimenter and with inherently uncertain results. Instead of assuming the public to be lay people (Irwin and Wynne, 1996), the company could be interested in the citizens' perspective and base their project thoroughly in the community.

Practically, understanding the project as a real-world experiment would mean not to rely on a 'deficit model', but to grant people a say at every stage of the process, and to acknowledge their local knowledge. People would become participants and shapers in an experiment that is conducted together *with* them, instead of *on* them. People like Richard, one of my interviewees from a local NGO, which monitors the mining company's activities. In our interview Richard pointed out that the 'beneficiaries' of the CSR project never had a say in *how* questions and the overall design of the experiment. They can report adverse reactions and their dislike of the smell of a particular insecticide, or refuse to take part in the spraying. However, he stated that no public inquiry on the potential content and nature of the CSR project had been conducted before the intervention started. Furthermore, the company's choice to concentrate their activities on malaria ignores long-standing demands of the community to cover abandoned mining pits as part of the company's corporate responsibility to society. Abandoned open pits constitute a serious health hazard for the

---

65 As have come to light during the first eradication campaign (see *Chapter 3*), in the development of malaria drug resistances, which have necessitated a complex and problematic malaria treatment shift (see *Chapter 5*), as well as endanger the effectiveness of ITNs (see *Chapter 7*).

population, and additionally can create breeding spots for mosquitoes[66]. Accordingly, my interviewee says that to him the philosophy of the project is wrong. It does not acknowledge that the company's practices might have created mosquito breeding places, and to him a responsive and responsible CSR project would have started with the question of 'what led to breeding grounds?' He argues the project has taken the wrong starting point, and hereby marginalised local demands as well as expertise.

Thus, it seems that in Obuasi –even though the malaria project is currently highly successful and has attracted national attention– a chance to engage differently with the public has been missed. It is doubtful if this would be in the interest of the gold-mining company. For instance, it certainly remains a pervasive question why AGA chose to ignore the long-standing demand to cover the pits. The representative of the NGO might well be right, when he says that this would have been much more expensive for AGA then investing in IRS. And as we will see in the 'closing outlook' of this chapter, it would have probably also attracted much less positive attention on a national (and international) level. However, while covering the pits might have not achieved as spectacular malaria reduction rates as spraying, it might have well proven to be the more sustainable strategy against malaria, and additionally prevented people from falling into the pits and sustaining (serious) injuries.

5.6 The things to come: The gold-mine as national malaria expert

It is the public health version of spraying that will expand in Ghana over the coming years, and the gold-mining company's project has been influential in this respect. The project's start in 2006 was timely as it was also the year in which the WHO malaria section officially rehabilitated insecticide spraying (and DDT) in the fight against malaria (WHO, 2006). This, coupled with the success of the programme, quickly made the project famous in the malaria and mining communities in Ghana. AGA for instance advised competitor Newmont Mining

---

[66] If they are not contaminated by cyanide or other chemicals that are involved in the gold-mining process. The company has been accused of contaminating local streams and rivers with cyanide (Action Aid, 2007).

on IRS, and agreed to train 19 of Newmont's sprayers. The same is true for a IRS project of US AID's Presidential Malaria Initiative (PMI), whose sprayers have also been trained by AGA. For the beginning of this project the community liaison manager even got seconded to PMI for some weeks. Further, "the WHO, the United Nations Children's Fund (UNICEF) and the Netherlands Embassy have sent observers and researchers to be shown the programme and trained" (AGA, 2007: 17). And as many organisations came to visit, the word got around that the project is interesting and successful.

And so the AGA project finally also convinced the NMCP, which was initially doubtful about spraying, of IRS's future potential for Ghana. With the support of AGA, the NMCP submitted a proposal to the Global Fund to Fight AIDS, Tuberculosis and Malaria[67] (GF). The proposal asked for US$ 158 million over five years (ibid), the IRS component is 122 million out of total (ibid: 77). Principal Recipients of the grant are the Ghana Ministry of Health and AngloGold Ashanti. AGA has been selected by the GF's country coordinating mechanism as the principal recipient for the IRS component (GFATM, 2008: 25). In November 2008 the GF announced its grant decisions and this time Ghana's proposal got approved.

The project is funded for five years and has started beginning 2010. The project now qualifies as a public-private partnership, with AGA administering the by far biggest share of the GFATM money. Not only for the NMCP has this meant a major success, but also for AGA. Firstly, their approach has now received national and international recognition. But secondly, they will also be responsible for the project on a more practical level:

---

67 The Global Fund raises money from various sources and calls itself 'a unique global public/private partnership'. The total pledges to date are US$ 11,229,463,496.3685 from various public national funds and US$ 622,855,694.47 from so called 'other' sources. Here, the GF 'accepts contributions from individuals, businesses and private foundations' (http://www.theglobalfund.org/en/mobilization/). Currently, the biggest part of money from 'other' sources comes from the Bill and Melinda Gates Foundation (450,000,000), followed by the (PRODUCT) RED initiative (112,885,581.13). In total the GF has up to now raised US$ 11,852,319,190.8385. GF estimates calculate that US$ 15 billion would be needed to prevent and treat AIDS, TB and malaria. The pledged money for one year, however, is e.g. for 2009 only US$ 2.6 billion. So, even if one buys into these estimates we are long not there.

IRS implementation will be carried out by the PR / Implementer - AngloGold Ashanti. The detailed implementation strategy and operations plan will be based on the "Obuasi model" (see Annex 10) and the planning team will be led by the experienced operational staff and management existing at Obuasi. All planning will be done in collaboration with the National Malaria Control Programme. The IRS implementation plan will be developed upon the experience and the best practices of the AngloGold Ashanti Mining Company who have been implementing an IRS programme in the Obuasi mining community since 2005. (GFATM, 2008: 44)

Thus, AGA will effectively lead the biggest public health project on malaria in Ghana, and the NMCP becomes merely a collaborator. But what could be the conclusions for this unfolding scenario based on the analysis of this chapter? I have argued that the spraying project in Obuasi might be understood as a real-world experiment. Knowledge in the project cannot be held stable, but it rather constantly in movement. In order to conduct a successful malaria control intervention a constant movement between laboratory analysis and field data collection is necessary. Mosquitoes and parasites adapt to the intervention and this makes them into active participants in the experiment. The world changes through the intervention and shifting mosquito population dynamics require an adaptation of the intervention in return. World and experiment are intertwined and shifting, in constant movement.

Furthermore, I argued that taking this dynamic seriously also implies re-conceptualising the spraying project. While insecticide spraying is generally recognised as a public health intervention that has a (scientifically) proven benefit to the public, I suggest that the uncertainty attached to the project requires us to open up this understanding. If the changing ecologies are seen as an integral part of the project, this not only means that the

project becomes experimental in character, but also that its results and benefits might be less clear than assumed by the concept of a public health intervention.

Rather than criticising the spraying project as ineffective and potentially more harmful than beneficial, I propose that an acknowledgment of the project as a real-world experiment, might make a difference to how we understand and conduct such projects. I argued that a real-world experiment is characterised by its uncertain and open ended results. There is no final victory or defeat, there are only changing ecologies. And such an understanding of the project has another important implication, it requires us to relate to the project's 'beneficiaries', to the public, differently. In a real-world experiments scientists, mosquitoes and the public are all taking part, participate in the experiment. Thus, they should all have a say in how ecologies are changed and adapted because they cannot be fixed or made stable. An acknowledgment of the project's status as a real-world experiment would mean to start experimenting *together with* local people instead of experimenting *on* them.

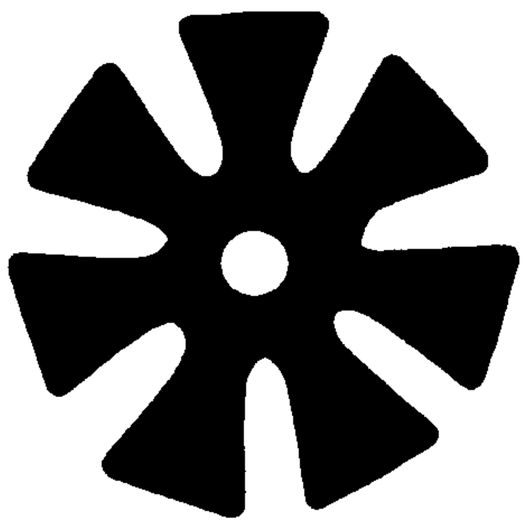
Based on this analysis we can ask: What will the expansion of the real-world experiment IRS over 40 districts mean ecologically for Ghana? Does the Kumasi football club motto point us into the right direction, when it states "If you kill thousands, thousands will come"? Will wide-spread spraying in Ghana harbour insecticide resistance in the long run, and make the mosquitoes more resilient instead of protecting the human population from malaria? The repertoire of insecticides available for IRS is very limited; currently 12 insecticides from 4 classes are recommended (WHO IRS, 2006: 6). The four classes of insecticides target only two neurological sites in total, which means that cross-resistances between the different insecticides are common (Brooke, 2008). Currently in Ghana, insecticides of those four classes are used for insecticide-treated bednets, spraying against insect pests on cocoa and cotton plantation and for IRS (for more on cross-resistance see *Chapter 7.3*). In the light

of this and potential consequences of resistance, one has to ask if the $122 million are a good investment of the GF in sustainable malaria control? Who will bite back first in this game of intervention and response? Human or mosquito? And what would it mean if we started to perceive insecticide spraying –but also malaria control more broadly– as real-world experiments? I will come back to those questions in the *Conclusions*. While this chapter has explored how a concrete malaria control intervention looks in practice, the next chapter inquires into definitions of malaria. It asks where and how we can locate malaria through *practices* that constitute or simply *do* malaria.

Blank Page

Chapter 6:

Locating Malaria



ANANSE NTONTAN

"Spider's web"

Ananse, the spider, is a well-known character in African folktales.

Symbol of wisdom, creativity and the complexities of life

> But surely the first step is to consistently recognise that there are many entanglements in every action. To keep practicalities unbracketed. To treat everything in medicine as a practice. To engage in a praxiography. Praxiographic stories have composite objects. Disease is no different in kind to hospital stays or daily life. Each flows into each other. (...) The praxiographic approach allows and requires one to take objects and events of all kinds into consideration when trying to understand the world. No phenomenon can be ignored on the grounds that it belongs to another discipline. (Mol 2002: 156-8)

After we explored the specifics of one malaria control intervention in the last chapter, this chapter zooms out from one particular intervention, and aims to think more broadly about definitions of malaria. It asks what malaria is, and inquires into where it can be located and defined. It is concerned with *what* and *where* questions. This is an attempt to create a

praxiography of malaria, of malaria in Ghana more precisely. Following Annemarie Mol's lead in *the body multiple* (2002), where she develops an ethnography of atherosclerosis as a disease, this chapter discusses four enactments/practices that locate malaria. I argue that each practice in itself creates a version of malaria. More importantly, the practices taken together and juxtaposed with each other, let a complex definition emerge of what we might understand 'malaria' to be.

A praxiographic approach cannot hold big and small, local and global, general and specific, abstract and concrete neatly apart, since it starts with the moment of practice itself – the habitual coming-together of diverse elements (Mol, 2002). While Annemarie Mol's study focuses on practices located in one hospital, the malaria practices discussed here *relate* to malaria in Ghana. However, not all the discussed practices are *located* in Ghana. This chapter argues that if we want to understand malaria in Ghana, social scientists cannot limit themselves to a geophysical location but need to include other locations in the conversation.

The last decades have seen a turn towards relational theories, where the investigation of flows and networks has taken centre stage. This has destabilised binaries of 'local' and 'global', and instead scrutinise complex connections. Such approaches underline that every 'global' is constituted by and arises through 'local' processes. Spatially, the challenge is, thus, to imagine (and write) the world not in topographical terms, and so to not conceptualise malaria as having local realities while raising global questions – those processes are rather to be understood as coextensive and intertwined (Massey, 2004).

Secondly, if we attempt to understand malaria as a complex disease, we need not only include more than one locality but also consider more than one story/epistemology/reading of history as relevant. Rather than being singular, malaria is located within a "simultaneity of

stories-so-far" (ibid). A master narrative disappears, or as Tsing has put it: "As soon as we let go of the universal as self-fulfilling abstract truth, we must become embroiled in specific situations. And thus it is necessary to begin again, and again, in the middle of things" (Tsing, 2005: 1-2).

Accordingly, the question this chapter asks is what might happen if we start our stories "in the middle of things" and define malaria as a socially, biologically and spatially complex phenomenon? Of course, the elements that define 'malaria' in this chapter are far from exhaustive, and as Law points out this is impossible: "There is no overview and neither is there any assumption of coherence. In this way of thinking the global lies within each site and is small, sensuous, specific, heterogeneous, noncoherent, and cannot be more than patchily modelled" (Law, 2004b: 13).

In the following 'social' is not reduced to humans but rather conceptualised as an assemblage of human, mosquito and parasite trajectories (Latour, 2005). The actors in the 'patchy' definitions of malaria offered range from Alphonso Laveran's microscope, lively Cambodian parasites to peoples' everyday understandings of disease on the streets of Accra. After presenting four possible definitions of what malaria might be, a concluding section will briefly discuss the question of how these four malaria realities might hang together, and outline why such malaria objects have to be thought together when we attempt to define malaria control in Ghana today.

6.1 The (dangerous) wanderlust of an Asian plasmodium falciparum parasite

As we have briefly heard in the *Introduction* already, a region in the borderlands between Cambodia and Thailand gets singled out in the international press coverage on malaria. This interest is based on newly released study results that prove the emergence of

artemisinin resistance. Noedl et al wrote a letter in late 2008 to the editor of the *New England Journal of Medicine* reporting evidence for artemisinin-resistant malaria in this area. In their study they find that out of 60 patients treated with artesunate (mono-therapy) four patients had reoccurring parasitemia, and two of those patients could be characterised as having artemisinin-resistant infection. The authors conclude:

> The high overall treatment efficacy seen in patients treated with artesunate indicates that relatively few parasite isolates have crossed the threshold of artemisinin resistance as defined in our study. Artemisinin resistance does not seem to be a widespread epidemiologic phenomenon at this time. The prolonged parasite-clearance times and the two cases meeting our definition of artesunate resistance are nonetheless a concern. (ibid: 2620)

Resistance against artemisinin is not a major problem as yet in the region, but the authors conclude it *exists*. Artesunate is today the only malaria treatment that is both highly effective and without major side-effects (as for instance quinine has). If artesunate loses its effectiveness, the success of malaria treatment worldwide is endangered.

This development is all the more threatening since it happened before: in the 1960s parasites became resistant to chloroquine. Since its discovery in the late 1930s, chloroquine was popular as first-line malaria treatment all over the world; it was not only highly effective but also a cheap treatment with minor side-effects. However, after the development of resistance, chloroquine had to be phased out in malarial countries, plummeting malaria control into crisis. Shortly after chloroquine, treatment with sulfadoxine-pyrimethamine[68], another common antimalarial drug, started to fail as well.

[68] The drug is commonly known as SP or as Fansidar (the first brand name).

Interestingly, all three resistances, not only the one against artemisinin, were first detected in the exact same region in Cambodia/Thailand. The mountainous forest area around Pailin, in north-western Cambodia and eastern Thailand, could be named the birthplace of malaria drug resistance. Pailin is not only well-known as a gem mining area – an activity that albeit being highly profitable also caused considerable environmental damage in the region, but also for having been a stronghold of the Khmer Rouge until as late as 1996. Today, it remains one of the areas that are most heavily contaminated by land mines. The birthplace of resistance is a troubled area, not only when it comes to malaria.

But, as the history of resistance against chloroquine teaches us, newly configured parasites – slowly but steadily – broaden their borders. In the 1950s resistance was first reported from Pailin, radiated slowly and inexorably outward from there, first spreading in the South-East Asian region and appeared in East Africa in 1978 (Plowe, 2009: S12). Rather than having a new mutation emerge in Africa, it has been demonstrated that the mutations leading to resistance in Asia and Africa are genetically identical (ibid). Thus, the resistant parasites must have travelled somehow from Asia to Africa. Resistance presumably travelled from Asia to East Africa in humans: according to Campbell et al. (1979) it is likely the parasite hitched a ride with South-East Asian workers, who came to East Africa in the 1970s to built a railway from Beira in Mozambique to Kinshasa in DR Congo (then Zaire). Malaria resistance travelled in *people,* the workers unknowingly helped spread the resistant parasite in Africa. And as has been discussed in the *Introduction* already, from East Africa the resistance broadened its borders slowly but significantly, continuing to travel overland, reaching West Africa, including Ghana, last[69].

---

[69] Here, it is important to keep in mind that the concept of resistance does not mean drugs fail in 100% of the cases. It means that the efficacy of a drug is reduced, but as we will see in section three, for some people the drug might still work well. Resistance is a gradual, not absolute phenomenon.

After the emergence and spread of resistant parasites, first-line malaria treatment worldwide had to be replaced by another antimalarial drug, artemisinin. And now the indicators from Pailin are clear, two recent studies confirm resistance against artemisinin (Noedl et al., 2008; Dondorp et al., 2009), and these results are potentially endangering malaria treatment yet again. As Dorndorp et al. argue containment of resistance is vital, given the region's history and the parasite's wanderlust:

> Chloroquine and sulfadoxine-pyrimethamine resistance in *P. falciparum* emerged in the late 1950s and 1960s on the Thai-Cambodian border and spread across Asia and then Africa, contributing to millions of deaths from malaria. (...) Measures for containment are now urgently needed to limit the spread of these parasites from western Cambodia and to prevent a major threat to current plans for eliminating malaria. (ibid: 466/7)

This is why the subject grabs the media's attention at the moment; WHO and all major malaria initiatives –such as the US President's Malaria Initiative (PMI) and the Bill and Melinda Gates Foundation– have expressed their concern. Gates has agreed to support the WHO containment programme in Cambodia/Thailand with 14 million US$. And as the head of PMI, Admiral Ziemer, commented in the New York Times: "We feel that we not only have to beat the drum but shake the cage: guys, this is significant" (Fuller, 27/01/2009). It is significant because it has the potential to change the definition of malaria yet again. And thereby redefine and diminish treatment options.

This is the parasite, plasmodium falciparum, in action – (re)defining malaria. If until July 2009 (if we take the publication of the paper by Dondorp as a date) malaria was a disease

caused by plasmodium parasites, transmitted by anopheles mosquitoes, and treatable by artemisinin in roughly 48 hours, this has today risen to 84 hours in Pailin (Dondorp et al., 2009: 455). The hours measured are so called 'overall median parasite clearance times', meaning the time it takes until the parasites are eliminated from the human blood. For now, malaria is a disease that can still be treated with artemisinin, probably in most regions of the world in roughly 48 hours with artemisinin. However, although artemisinin can still defeat the parasites in Pailin, it does so at a much slower pace.

And, as the history of malaria has showed us, this trend will continue. Resistant parasites have a survival advantage over nonresistant ones and hence will multiply and spread[70]. And so a different version of malaria is created – a version of malaria to which there is no known cure so far. This is the first definition of malaria I would like to offer. A version that –we can speculate– is not only created by vicious parasites, but helped into being by a confluence of complex factors in Pailin.

The resistance against chloroquine has so far been explained by a failed state intervention, while the emergence of artemisinin resistance tends to be blamed on unruly citizens using artemisinin as mono-therapy, or worse producing counterfeit malaria drugs that foster resistance (Dondorp et al, 2004). However, this explanation is rather unconvincing since both phenomena appear in many regions of the world, particularly Africa (Bate et al, 2008). According to James Scott's recent study (2009), the highlands in South-East Asia has for centuries been populated by people actively evading state structures in the lowlands. Scott states that "'*escape agriculture*': forms of cultivation designed to thwart state-appropriation"

---

[70] Generally, the spread of resistant parasites is of increasing importance in global health, it for instance focus of a recent special issue in focus *Emerging Infectious Diseases*. The editors call for more attention "on the intersection between the travel and migration medicine and public health communities to improve the control and prevention of infectious diseases in globally mobile populations" (Arguin et al., 2009). Articles of the special issue explore the increase in various im/exported (tropical) diseases around the globe. This is not only a health concern on the rise, but also another way in which divisions and connections between developed and developing world get re-inscribed.

(ibid) were an integral part of autonomy-seeking practices. Since *Artemisia annua* grows especially well in highlands we can speculate that it has circulated in the region for centuries, and was part of Scott's "escapist crops". Did the introduction of chemically produced artemisinin constitute an ecological tipping point, and led to the emergence of resistance? No comprehensive study exists so far, but a convincing explanation of the rise of resistance would need to integrate socio-historical, environmental and political processes.

Ultimately though, this new version of artemisinin-resistant malaria got created by tiny, mutated protozoan parasites, a eukaryote – just like the symptoms of the disease. The parasite invents and reinvents malaria. But it is not the parasite alone that creates and defines malaria, it does so in interaction with mosquitoes and humans. Human practices are crucial to understanding the disease too, and this will be explored further in the next section.

6.2 The Streets of Accra: Living *with* malaria

In 2005, the resistant parasites from Cambodia made a drug policy change in Ghana necessary. After a national deliberation process and a scientific study into several ACT drug combinations (Koram et al, 2005), the first-line malaria drug chloroquine was officially replaced by artesunate-amodiaquine. The implementation was not smooth, but by now the bigger public health institutions in Ghana are using the ACTs. In everyday life, however, there is more variation in malaria treatment: Many malaria cases will never be seen by the hospital, and a great variety of treatment gets used against the disease. Let me stay with the biomedical treatment options for a bit. Many people, with whom I chatted about their malaria drug taking habits, tell me that they neither like nor take artesunate-amodiaquine, the ACT recommended and supplied by the Ghanaian government. They say it makes them weak, they find it hard to go to work when they take it.

There is for instance Kwaku, whom we met already in the *Introduction*, and whose habits are similar to those of many people I chatted to – he tells me that he usually buys artesunate as mono-therapy when he feels feverish. Kwaku, just like most people who have grown up with malaria, is aware of his own malaria symptoms. To him there is no need to spend precious money (and time) in the hospital for a diagnosis, where –as he complains– the doctor or nurse often wouldn't do a blood test for him anyways and rather just prescribe malaria medication. And amodiaquine, no – he does not like it, he says, it makes him too weak. So Kwaku ends up buying artesunate mono-therapy in a pharmacy, which is readily available in Accra.

Another example is Arthur, an employee of the Malaria Vaccine Trials in Agogo, who tells me that his favourite antimalarial is still chloroquine. Arthur is well aware of the treatment failures chloroquine has, but for him personally the drug still works fine, he says. He does not experience many side-effects, it is cheap and removes the parasites quickly from his body. Ghana is phasing out chloroquine, but –as I learned from the NMCP and the WHO Country Advisor– this is a slow process. Ghana still had two years of chloroquine supplies when the head of the NMCP announced in April 2005 that chloroquine was to be phased out within a year (Health News 05/04/2005). In summer 2008 it is, however, still purchasable in Ghana. Arthur observes that it is increasingly harder to get, but it is still possible.

People buy various antimalarial drugs over the counter (in a variety of pharmacies)[71] - artesunate mono-therapy as well as the standard drug artesunate-amodiaquine. Some people, if they have heard about it and can afford it, prefer *Coartem*. *Coartem* is a combination of artemether and lumefantrine, produced by Novartis and is meant to have

---

[71] A practice that is more and more recognised as standard treatment and as to be taken into account in policy making. It has, for instance, led RBM and AFfM to include private sellers. A recommendation that, however, remains controversial because it decouples adequate malaria diagnosis from treatment, which is (inter alia) a challenge in the fight against resistance that can be triggered by over-diagnosis and -treatment.

less side-effects than artesunate-amodiaquine. *Coartem* is meant to be the best ACT drug on the market, but also the most expensive one. In Ghana *Coartem* cost nearly 10 GHC in 2008, which compares to 4 GHC for artesunate-amodiaquine on the commercial market[72].

And then, of course, people do much more against malaria than just taking drugs that are recommended by the clinic, government or sold in pharmacies. Herbal medicine, spiritual ceremonies, a variety of protective measures and many more activities represent strategies against fever/malaria. In Twi the term that mainly gets used when referred to malaria is *atiridii*, which people translate to me as fever[73]. *Atiridii* is officially recognised as the Twi word closest to 'malaria', and gets utilised in (some) malaria campaigns of the NMCP. Fevers in Twi-speaking communities (and more generally in Ghana) are, however, distinguished by different symptom categories and causal explanations than western-scientific disease categories. The variety of fever/convulsion diseases overlaps with western-scientific malaria in complex ways, but are certainly not coextensive. The epistemological relation between different malaria treatments is not the subject of this study, but for instance Stacey Langwick offers a beautiful, symmetrical exploration of encounters between malaria and the Southern Tanzanian fever disease 'degede' (Langwick, 2007). Here is, however, one brief comment that Martin -a Ghanaian MSc student in the Health Geography programme at Kumasi University- made during one of our group discussions in a seminar on *Environment, Health and Malaria in Ghana in 2008*. This is what Martin had to say about other than biomedical approaches to malaria treatment:

---

[72] 10 GHC are roughly 5 GBP. Those prices can again be compared to the drugs are available in public hospitals or health centres, which cost 0.30 GHC (subsidised by Ghana Health Service) or are free if the patient is insured with the NHIS. However, a generic version of Coartem called Lonart produced by GVS Labs from India, is widely publicly available for a similar prize to artesunate-amodiaquine, around 4 GHC.

[73] The Twi-English/English-Twi dictionary (Kotey, 1998) translates 'atiridii' with 'fever/malaria'. And 'malaria' with 'atiridii' and 'hurae' (a term I came across too, but only in Ananekrom).

> Everybody is talking about what happens after you have malaria and even with that I ask myself if we have considered the fact that lots of our people use herbal medicine and how is this herbal medicine infused into malaria treatment? I was feverish yesterday and I was taken to an old woman, she showed me some plants to boil and I was thinking: Well, although I did not stick to her message that means that for her when she gets the malaria she would not think about going to the drug store or the hospital. So let's also focus on how to infuse this herbal medicine into our medical system. (Martin, group discussion, 2008)

Herbal medicine would not treat 'malaria', but it might still be effective against the symptoms that a doctor in the clinic would call 'malaria', or what the malaria microscopist would visualise as plasmodium parasites. The point here is that different everyday practices to treat fever and sickness also offer definitions of malaria. The woman in the case above "would not think about going to the drug store or the hospital", malaria/fever to her exists in a different onto-epistemic realm and requires different actions from her. It does not matter much if these diseases could or could not be visualised as malaria under a microscope (as we will see in the next section parasites seen under a microscope are not easily equated with malaria either); it is important to recognise that people through their practices define the disease. This is the second version of malaria I would like to offer: Malaria is located in *the practices of the patient*. It comes into being differently according to what patients feel and self-diagnose, where they go for support and how they (get) treat(ed) themselves. In the following section a third version of malaria is concerned with parasites again (which are, it is to be noted, entirely invisible/absent in the second version). More concretely the next section unravels the practices that aim to render parasites visible to the human eye, malaria microscopy.

6.3 Visualizing malaria: "There is a difference between having malaria and the parasite being in the film"

A third way to locate malaria is in the blood. The process, with which the malaria parasite triggers disease in humans, starts when it enters the red blood stream. Put simply, the parasite enters erythrocytes, multiplies within the cell and causes it to burst. Cell remains then agglomerate in various human tissues or organs, such as the heart, liver and brain. The loss of red blood cells and the blocking of vessels and organs makes humans ill (worst of all is the agglomeration of erythrocytes in the brain, causing 'cerebral malaria'). And it is here, in the erythrocytes, where malaria as a disease gets located via laboratory diagnosis.

Broadly speaking three different laboratory techniques exist to identify malaria parasites in the blood stream: The classic tool is the identification and counting of malaria parasites (MPs) in a blood sample visualised and magnified by an optical microscope. More recently, two more technologies have been developed: (a) antigen rapid diagnosis tests (RDTs), and (b) molecular diagnostic techniques detecting parasite nucleic acids by using polymerase chain reaction (PCR).

Over the last years, rapid diagnostic tests have become more popular, mainly because they consist of a simple and mobile testing kit that neither requires electricity, nor does a successful reading of the result need much training. RDTs hence can be used easily and everywhere, crucial advantages in regions where there is no microscope, electricity, trained malaria microscopist, or all of the former[74]. And since those are regions where malaria is rife, RDTs are of immense importance, and as MSF convincingly shows can improve peripheral/local diagnosis and treatment of malaria greatly (MSF, 2008).

---

[74] Recently, there has been progress to make microscopic diagnosis more mobile and not that much dependant on electricity. Breslauer et al developed 'an attachment for a camera enabled mobile phone such that it can be used as a platform for high-resolution clinical light microscopy' (Breslauer et al, 2009:4). Such a device could travel with mobile public health care teams or even used in Health Centres without stable electricity.

However, RDTs are less accurate in detecting malaria than the other two techniques, molecular analysis is recognised as the most reliable method to detect malaria parasites in a body. But it is an expensive technology that not only requires the availability of PCR technology in a laboratory but also highly skilled technicians. And thus it is not a realistic alternative for routine malaria testing and broad implementation. The gold standard in malaria diagnosis remains microscopy, the same technique with which the parasite got first visualised in the biomedical community.

The man credited with the discovery of the malaria parasite is Charles Louis Alphonse Laveran, who in Algeria "on 6 November 1880, in examining the blood of a young soldier, (he) saw at the edge of one of the spherical corpuscles several actively moving filaments" (Bruce-Chuvatt, 1981: 531). Those moving filaments Laveran later identified as the cause of malaria and initially named it "oscillaria malariae". His observation was the beginning of the scientific discovery of the genus plasmodium, the parasitic protozoa causing malaria in humans and animals. Leonard Bruce-Chuvatt, who was himself a famous malariologist, was clearly impressed by Laveran's visual accomplishment on the microscope:

> One must not forget that Laveran saw the new bodies in a fresh, unstained blood-film, on a slide under a coverslip, using a microscope with a dry lens (1/6") giving a magnification of about 400 diameters. One can only admire his eyesight and his powers of observation! (ibid: 532)

But not only Alphonso Laveran needed excellent eyesight to identify malaria parasites in blood, today in the laboratory of the Agogo Presbyterian Hospital in Ghana, malaria microscopy receives special attention too. On my first tour through the laboratory I learn that

the malaria microscopist has a whole room to himself. While the rest of the lab feels cramped and is buzzing with people and sounds, the malaria microscopy room is spacious, quiet and calm. There is only one microscope on a table in front of a nice window, the rest of the room is used as storage space for lab materials. Yaw, my guide through the lab, explains to me that the room was chosen for malaria diagnosis because "one needs a silent room with a nice atmosphere for malaria microscopy. Malaria microscopy is demanding, it requires a lot of concentration. Especially the species identification is hard", he says.

Malaria microscopy in Agogo typically proceeds as follows. A few blood drops get taken from a prick in the finger tip of the person to be diagnosed. The blood taken is dripped on two slides, one to prepare the so called thick film, and a second one for the thin film. The thick film is a conglomeration of blood cells and mainly used to determine if MPs are present in the blood. The thin film is prepared with less blood cells, which are spread out on the slide. This enables a better visualisation of the blood cell's interior, and thus allows one to see the form of organisms present more clearly. The thin film is used to identify which plasmodium species is present and (usually[75]) to count the number of MPs present.

There are two WHO-recommended systems to count parasites (WHO, 1991). The first one is slightly more complex, and involves relating the count of leukocytes to parasites. One counts 200 (or 500 leukocytes, in case there are under 9 parasites present when 200 leukocytes are counted) and then relates the parasite count to the number of leukocytes. The second, slightly simpler and hence in practice probably the more popular system, is commonly called 'the plus system': Here simply the number of parasites in the blood get counted. The microscopists scans 100 fields (one field is defined as the area seen under the magnification without moving the lens) and if he/she finds 1-10 MPs it is +, a mild

[75] In case there is low parasitemia in the blood, MPs might be hard to find in the thin film (because there are less red blood cells present in the thin film), and so the microscopist might have to go back to the thick film for MP counting.

malaria, if there are 11-100 MPs present it's ++, moderate malaria, if you however find 1-10 per 50 fields it is severe malaria and +++ (WHO, 1991).

Both techniques seem fairly straightforward, but only in theory. One potential stumbling block, for instance, are 'artefacts'. I was allowed to spend some time with the malaria microscopists in their quiet room, and on my first day Godson, the microscopist on duty, taught me the basics of malaria parasite detection. I could find out for myself that it indeed is challenging. After practising on many slides I thought I finally had a first grip on identifying the parasite. Godson, however, quickly proved that this was not the case by introducing me to one of the subtle challenges that malaria microscopy poses. He showed me one thick film, where in the middle there was something that looked like a parasite to me. He said, "Yes, it does, but it is not. It is an artefact". Godson explained that this organism is all blue, the cytoplasm also and this should not be the case, it has to be red. So, if all is blue, even if the form is correct, this is an artefact, a 'false parasite' as he termed it. He explains to me that if you declare a slide 'positive' you need to have seen at least one 'typical parasite' with all the features, if not, the slide is 'negative'. If it is 'positive', one typical parasite will be there. I had so far only learned to identify the *form* of the parasite and did not pay any attention to the *colour.* And this was not even an attempt at malaria species identification, which is the by far bigger challenge in malaria microscopy.

Artefacts – other organisms present in the blood such as fungi or microfilariae, can make malaria microscopy challenging[76]. And so can other changes in the blood. In a laboratory course on malaria microscopy in Agogo, an interesting discussion about the specificity of optical microscopy emerged. It circulated around what 'malaria diagnosis' actually means. One microscopist made the point that "the whole diagnosis is relative anyway. Sometimes

---

[76] For a discussion of 'artefacts' in malaria microscopy see Chapter 9 in WHO (1991)

you see the parasite, sometimes you don't. There is *luck* involved". In this context, another one remarks that inflammation or bacteria (changing the ratios of leukocytes and erythrocytes in the blood) would cause the microscopist to scan less fields (since the rule is to scan 200-500 leukocytes). At this point of the discussion the trainer intervenes, and adds another aspect of uncertainty:

> If a patient has malaria you are expected the see MPs. But with low parasitemia this does not have to be the case. Ideally, this is the case, but not in reality. Sensitivity, even for experts, is therefore not defined 100%. (John, 2007)

In other words, there is indeed luck involved. If one has a bacterial infection, if there are only few parasites in the blood and/or if the malaria infection is in early stages, even very experienced microscopists might miss the presence of MPs. Especially if the microscopist has to scan many slides per day. The trainer hence suggests that a good malaria microscopist needs to develop an 'eagle eye': "This means one should see every detail from above, like the eagle spots the prey, even from afar. One should scan every slide with an eagle eye and see the parasite hiding. Every detail needs to be seen before one moves on to the next slide" (John, 2007).

This already shows that experience and practice are very important to the quality of microscopic diagnosis; the trainer also underlines that constant training is necessary, as he put it: "If you have not been on the mic for some time, you'll lose your eye and need to practise again". But the challenges with malaria diagnosis do not stop at identifying MPs in the blood. For the microscopist it does, he/she reports the result 'no MPs seen, +,++ or +++', and the laboratory sheet goes into the consulting room. And herewith leaves the second part of diagnosis to the doctor. The consulting room is the space where clinical

symptoms and laboratory diagnosis come together. For the doctor, however, having MPs confirmed in the blood does not mean that a person has or develops malaria (symptoms).

From an epidemiological perspective on diagnosis Koram and Molyneux in their article "When is 'malaria' malaria? The Different Burdens of Malaria Infection, Malaria Disease and Malaria-like Illness" (2007) distinguish malaria as (i) an illness/disease, as (ii) a term for protozoa parasites (as used in the concept 'malaria transmission') and as (iii) a public health problem. They urge the scientific community to pay more attention to distinguishing these different malarias, and develop the concept of 'signatures of malaria'. Signatures are a diagnostic heuristic combining clinical and laboratory methods, and the different signatures are to be read in relation to each other. Those signatures together then constitute the disease malaria, as they put it: "More 'signatures', either clinical or laboratory-based, are needed by which clinical events and parasites can be more confidently linked" (ibid: 4). Malaria diagnosis is an active process of movement between laboratory results and clinical symptoms of a patient.

Furthermore, Koram and Molineux state that malaria diagnosis also depends on the context in which it gets diagnosed. For instance, it depends on the general level of malaria transmission in the area. Especially in areas where malaria is holoendemic (which it is in Ghana) people co-habit with parasites most of the year without developing malaria symptoms. This is due to an acquired specific immunity (Marsh, 2002: 256), which humans develop through continued exposure to malaria parasites and lived-through malaria infections. Specific immunity is thus mainly present in adults living in areas with constant, high malaria transmission. However, "it should be stressed that, even during the period of maximum susceptibility to severe disease, children spend the majority of their time parasitized but healthy" (ibid: 256). It is thus not only the presence of parasites in the blood

that causes malaria. Research in Ghana for instance has shown that parasites were present in approximately 58% of the population (Owusu-Agyei et al., 2009). This further complicates diagnosis, which is based on microscopic visualisation of parasites. Koram and Molineux explain some complexities that can led to over- as well as under-diagnosis:

> To conclude that the film-negative patients with febrile illness in these studies were misdiagnosed as malaria involves several assumptions: (1) that a negative blood film excludes malaria as a cause of illness—in populations living in areas of intense transmission, this assumption will nearly always be correct; (2) that the blood film has been competently made, stained and interpreted—27% of negative malaria films in one hospital study in Tanzania were judged on subsequent quality-checking to have actually been positive; and (3) that some subjects had not been rendered aparasitemic by an antimalarial drug a day or two before the blood sample was taken. Despite these caveats, it is undoubtedly the case that a large proportion of individuals presumptively diagnosed and treated as malaria are not suffering from malaria. (...) Where many in the population are parasitemic, overdiagnosis of malarial illness may be considerably greater than indicated by the proportion of clinically diagnosed subjects who are film-negative, because many of those who are filmpositive may also have another cause of illness, their parasitemia being "incidental". (ibid: 2)

As one of the microscopists in Agogo summarises those aspects and complexities nicely: "There is a difference between having malaria and the parasites being in the film". A person can have parasites seen in the blood and still not display symptoms of malaria, on the other hand a person can also be sick with malarious symptoms and not have 'parasites seen' written on their laboratory sheet. And then the concept 'malaria' refers to many things at the

same time too (Koram and Molineux, 2007), making (microscopic and clinical) diagnosis and the way we talk about the disease more complicated too.

Thus, in this section we have encountered a version of malaria that gets enacted through *visualising and counting* parasites in the blood stream. 'Malaria parasites seen' in the microscopic logic equals malaria, even if it is asymptomatic and would not qualify as the clinical disease called malaria. Furthermore, seeing parasites in the blood is a challenging practice – it requires attention to detail, an eagle eye and is hard work. So, the version of malaria that emerges in diagnosis is both an achievement and a contingent object. However, there is more to say about clinical diagnosis of malaria, in sub-Saharan African realities clinical diagnosis often does not come together with laboratory practices. And this is the subject of the following section.

6.4 Clinical diagnosing without technology: "I'm treating for malaria"

While laboratory diagnosis of malaria is the gold standard it is certainly not the norm in malaria diagnosis in Ghana, and sub-Saharan Africa more broadly. As Médecins Sans Frontières (MSF) in a recent report put it:

> Currently, the vast majority of diagnoses are made based on symptoms of fever at home or in health structures. Biological diagnosis, such as microscopy, often remains out of reach in many poor settings as it requires special equipment and trained staff which are often not available. This lack of precision in the diagnosis means that patients are not always treated for the illness from which they actually suffer and that drugs are not used rationally. (MSF, 2008: 7)

This is true for rural areas in Ghana as well, where (especially rural) health centres have to fight with lack of infrastructure as well as trained personnel. The empirical story I would like to share in the following forms no exception. Ananekrom is situated one hour drive eastwards from Agogo and is a small market village (connecting together widespread farming communities from an area that extends from Agogo's borders towards the Volta Lake (to the East) and the Afram Plains (to the South)). Agogo and Ananekrom are connected by a dirt road in bad condition; it is full of potholes washed out from a river, which makes the road frequently impassable in the rainy season. Sometimes, Ananekrom becomes like an island, it is cut off from main-road Ghana.

Ananekrom Health Centre (HC) is run by the Ghana Health Service. The Health Centre is headed by a midwife; no doctor is stationed in the village. The midwife, Madame Lamisi, is in charge of health care for 15 scattered farm state communities and the village Ananaekrom. The Health Centre got a new building in 2006, which was financed through a micro-project scheme of the Government of Ghana and the European Union. Ananekrom does not have electricity or mobile phone coverage, and the only treasure of the HC is a gas fridge for medication that needs to be cooled. The midwife is very experienced, she is in her 12th year in Ananekrom already and before that worked in several big hospitals in Ghana as well as managed numerous HCs in other villages. I spent roughly two weeks in Ananekrom, observing the practices in the HC, and (together with five geography students from Kumasi) conducted a participatory workshop on malaria with members of the public. And in the following I recall two examples of how malaria care got *done* in the HC in Ananekrom:

Health Centre, Ananekrom, January 2008

A six year old girl comes in, the midwife and health centre manager Lamisi told me that she has treated her for malaria a couple of weeks ago already. However, later her body swell up

and now she also coughs, her rips hurt, she breathes only with difficulty and has fever. Her eye lids also reveal anaemia. Lamisi says "I treat her for malaria and pneumonia". Lamisi puts the mechanic fever thermometer under the arm of the little child and exclaims "eey", because she discovers that the child wears two warm jumpers and in addition has a cloth wrapped around her body. Meanwhile the mother, who has a smaller child with her as well, breast-feeds the smaller one – it rather looks as if she is lifting empty skin then breasts for her child. The fever thermometer says 39.6. After this result Lamisi adds paracetamol sirup to the mix, where she had already put amodaquine sirup and the crystalline injection against pneumonia. (...) Later a baby also with malaria-like symptoms comes in. It is approximately six months old and has 38.6 fever. Lamisi gives paracetamol and amodiaquine syrup again. Diagnosis in Ananekrom is restricted to symptoms and the revelations of simple visualising tools. A fever thermometer and questions about symptoms, a lifting of the eye lid, the measurement blood pressure must suffice to make up the midwife's mind. Madame Lamisi carefully takes notes about her investigation, building up patient-histories. After she has listened to the story of the patient, asked a few questions, used some of the limited diagnosis tools on her disposal and has written everything down, she starts assembling the medication for the patient. It sounds ironic, and it is obviously a little bit too pointy to capture the complexity, but basically Lamisi distributes the available medicine to the symptoms of the patients.

However, it is important to note that this process happens with expertise and not randomly. She says to me, 'I am going to treat her for…' and not 'this patient has/suffers from…'. The name of the disease drifts in the background, one could even say that the concept of specific 'diseases' itself fades away. In Ananekrom visualising and identifying the parasite is not important, someone is either sick or healthy. If he/she is sick, he/she has to do

something, for instance take some medicine. What caused the illness, the characteristics of the illness, the definition is not that important, it is about getting better, being fit again.

Dr.Steve, who is a GP in a public, also underfunded, hospital in Ghana, which is only a 2-hours-drive away from Ananekrom, would probably call this 'the bombardment approach': One day when I was on a ward round with Dr. Steve he explained this approach to me while talking me through the diagnosis of one of his patients: He said that the women's stomach problems could be caused by many different small "organisms" (he mentions a few), but that "here in Ghana we use a symptomatic approach. Whereas you[77] use an etiological approach, identifying the different organisms underlying the illness, we use a symptomatic approach and then bombard the organisms. We surround them and bombard them so that whatever organism it is, it will die". "This works too", Dr.Steve says, "the only problem is that it can be poly-pharmaceutic".

In this version, malaria gets produced by the midwife or doctor while and by treating a patient; malaria emerges through diagnostic practice. A judgement that Madame Lamisi develops with the help of fever thermometers, with her hands discovering three layers of clothing at a little sick girl, with her eyes detecting anaemia on lifted eye lids, and her general medical expertise, which she built up over years and years of practice as a village doctor. And her diagnosis gets expressed as 'malaria' not necessarily in words, but through the choice of drugs that she prescribes. Or sometimes the choice of drugs leaves it open, the penicillin injection in combination with malaria tablets *treats for* pneumonia and/or malaria. The important part here is *treatment*, not malaria. So, this definition of malaria is characterised by its non-definition in a way. It is defined by the practice, the practice of the

---

[77] Meaning in 'developed' countries, which are relying more on 'technology' in their diagnosis. He was specifically referring to his training as a doctor, which he completed in Russia.

nurse as well as by the medication that is aimed at making the patient feel better. In this sense malaria care is entangled in medical "tinkering" as Annemarie Mol understands it:

> Care practices tend to not be linear at all. Facts do not precede decisions and activities, but depend on what is hoped for and what can be done. Deciding to do something is rarely enough to actually achieve it. And techniques do more than just serve their function – they have an array of effects, some of which are unexpected. Thus, caring is a question of 'doctoring': of tinkering with bodies, technology and knowledge – and with people too" (Mol, 2008: 12).

6.5 Malaria multiple?

Take those four examples in order to define and locate malaria, and we can see that things are rather unclear. Where is malaria? Does it get defined in Cambodia/Thailand as *Section 6.1* argued? Is malaria defined in Pailin, where parasites currently are busy inventing a new form of malaria – a malaria that is more virulent and dangerous for humans than older versions of the disease? Or, is the disease defined by the everyday 'street' practices of the sick people themselves as *Section 6.2* suggested? Here malaria comes into being through practices of self-diagnosis, and through buying medicine in a pharmacy, or through talking to old knowledgeable women, who recommend a concoction of herbs. It comes into being as a feeling of being unwell, and a routine with this particular unwell-being has led people to connect it to 'malaria', malaria is this particular feeling in the belly.

Or, is it rather located in the blood? Can we define malaria through visualising the parasite with an optical microscope? As we saw in *Section 6.3* that this is possible, though a challenging and far from straight forward process. And crucially, we learned that the presence of malaria parasites in the blood does not equal the disease 'malaria'. Or, fourthly,

does malaria come into being through the practices of health personnel in the countless health care facilities, where a microscope and electricity is a luxury? As we have seen in *Section 6.4*, many instances of malaria diagnosis in Ghana are based on simple diagnosing tools only, such as patient histories, fever thermometers, hands and eyes adept at revealing anaemic eye lids and attuned to the varying degrees of (malaria) symptoms. This is defining malaria by doing – via administering medication, and monitoring fever curves. It is defining malaria while practising medicine.

By putting those four definitions forward and next to each other, I would like to suggest that this is not an either or decision. Following Annemarie Mol, all four practices evoke malaria, they all situate, locate and define the disease. Malaria in this sense is multiple, it cannot be understood through one single practice, but is made and remade in a diverse range of practices – practices involving humans, parasites and microscopes, and much more. The versions of malaria that emerge are different, however they are not unconnected. Rather, if one concentrates on practices, it becomes apparent that seemingly unconnected phenomena "hang together" somehow (Mol), complement each other, or might also "interfere" with each other (Haraway, 1992). For instance, developing resistance in Cambodia might one day interfere with malaria drug efficacy in Ghana. Equally, the weakness of the public health infrastructure in Ghana makes laboratory diagnosis inaccessible to many Ghanaians. For many people the biomedical understandings of malaria are not affordable (time and money-wise), and/or do not overlap with their understanding of illness and health.

However, while arguing that malaria has to be understood as a complex and multiple disease, there is also a singularity to it. The parasite at the end of the day creates a single malaria: It reproduces and along the way makes humans sick. And within this singularity

there is an agency involved that is clearly nonhuman. It is this play between malaria's singularity as a disease experienced by one person caused by a parasite in one location, and malaria as a global assemblage of local and-not-so-local practices that malaria policy needs to engage with.

Furthermore, as we have seen in the case of resistance, while new definitions emerge in one locality they can redefine malaria globally. It took roughly 55 years (1950-2005) from the detection of the first chloroquine-resistant parasite in Cambodia until a policy change became necessary in Ghana. Resistance travelled slowly; nevertheless events in Cambodia eventually redefined malaria treatment in Ghana. The global emerges in/from the local. However, as the travelling resistance also shows it cannot be reduced to the local. If we want to think about what successful malaria control might mean, we need spatial imaginaries for malaria that account for movement, practices and interference. We need spatial imaginaries that connect Cambodia and Ghana. Topographical understandings will not be enough though; malaria needs to be understood as a focal, highly local disease, while at the same time than conceptualising it as mobile, multiple and moving.

And this is not only a theoretical point, but has consequences for policies aiming to control malaria. Malaria policies are often based on a logic of linear implementation: Global policy is assumed to be simply infused, or transferred into a local system, and (at best) translated into a local context. Equally, the logic of 'scaling-up' of interventions that *Roll Back Malaria* suggests a linear connection between local and global as well as between situated and universal interventions. Doreen Massey would call this a "problematic geographical imagination":

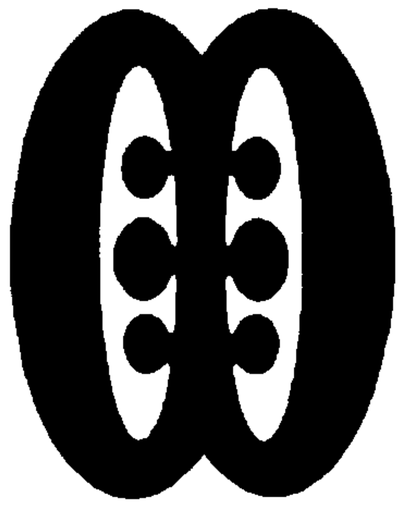
> All this, to my mind, rests upon a problematic geographical imagination. To begin with, it is to confound categories. The couplets local/global and place/space do not map on to that of concrete/abstract. The global is just as concrete as is the local place. If space is really to be thought relationally then it is no more than the sum of our relations and interconnections, and the lack of them; it too is utterly 'concrete'. (It is evident here how romanticising the local can be the other side of understanding space as an abstraction). (Massey, 2004:184)

It does not only matters *how* we build our abstractions, but this chapter aimed to show that it matters *how* as well as *from where* we build our abstractions. We need a global policy imaginary of malaria that thinks it as emerging from practices and as inherently local (in its connections to (inter alia) politics, economy, livelihoods and vector habitats), but at the same time does not leave global dynamics out of the picture. I will come back in more detail to those points in the *Conclusions*.

But first *Chapter 7* will ponder a question that directly follows on this chapter: If we understand the disease to be characterised by a diverse repertoire of practices –practices of parasites and mosquitoes, scientific and clinical practices or the everyday practices of patients, who are never seen by the formal health system– how can we then understand malaria policies? How well do policies work with and despite the tension between the global-local (for the want of better terms)? Can they hold the different malarias together? How does the ordering work? What escapes? At which cost? How can we re-imagine malaria control and policies? These are the questions the following chapter will attend to.

Chapter 7:

Policy Escapees – postcolonial politics meets bednets meets mosquitoes



ESE NE TEKREMA

"the teeth and the tongue"

The teeth and the tongue play interdependent roles in the mouth. They may come into conflict, but they need to work together.

7.1 Policy Overdose

There is an entry in my field diary from my second fieldwork month, November 2007, that is entitled 'Policy Overdose', and it reads as follows:

I leave the university after having met the WHO Ghana malaria representative and an epidemiology professor today. I feel shit, everything seems to work fine, people are nice and openly tell me the story of malaria policies and their implementation over the last years. Everything seems to work well, is smooth. Even the failures and problems my interview partners openly admit, discuss and explain me how the issues were solved – so what could I contribute? All is well, malaria control is in good hands. The international money actually helps to build necessary infrastructure for a working NMCP… mhhh. With this feeling I leave the offices of my interview partners from today. In the trotro [bus] on the way back, I realise, however, that I have already encountered many little incidences that don't fit to this policy narrative… still I feel a little frustrated.

My feeling of frustration came from two things. Firstly I felt useless, like an intruder who came to *do* something and *write* an interesting story, but who got unmasked in her ridiculousness, and whose efforts are superfluous. Secondly, and more importantly (for this chapter) I felt frustrated because I realised that this was the big story, the story of how things can be made to work successfully. The story of active agents, of describable and solvable problems and their possible solutions; the story of successful policies against malaria, which was responsible for reductions in malaria cases – Bill Gates' world if you like.

But my experiences in Accra so far told me that rather than the big policy things it was the small, not so smooth, not so easily connected, describable, solvable things that were responsible for an increase or decrease of malaria cases; or at least I realised that those things matter too and are mostly neglected in policy stories. This is a point that follows from last chapter, where I hope to have showed the importance of *practices* to malaria control. In the following related questions will be explored, but the focus of analysis will rest on the relationship between practices and *policies* – meaning different logics, agencies and practices involved in malaria control policies will be discussed, and interferences between those practices are traced.

Paying attention to different logics at work in policies is nothing new in studies of development and (science) policies. Rather, why policies work or do not work has been the focus of many studies. In *Science and Technology Studies* work has for instance focused on why 'technology transfer' was not working well across cultures. In this context, Madeleine Akrich showed how small changes in a technology-society network can result in the disintegration of the technology (1992; 1994). Ultimately, she argued that technology is not

fixed and context independent, but fluid and has to be understood and made to work in its socio-technological network (ibid[78]).

Work in development studies has also explored why development projects fail or have rather different effects than expected (Scott, 1998; Ferguson, 1994). For instance, James Ferguson (1994) has examined development projects and their effects. His study focuses on the de-politicizing potential of development projects in Lesotho. By examining their 'side'-effects, he comes to the conclusion that development projects there function as an "anti-politics-machine" "depoliticising everything it touches, everywhere whisking political realities out of sight, all the while performing, almost unnoticed, its own pre-eminently political operation of expanding bureaucratic state power" (ibid: XV). Ferguson argues that, with the help of development projects, political realities are transformed into technical problems, for which development agencies can offer managerial solutions. Hereby, however, political realities get marginalized. And, thus, on the basis of this, Ferguson has criticised development policies on a fundamental level, destabilising the workings of its underlying logic. While his work is extremely useful and has been highly influential, more recent work within development studies has regarded it as more fruitful to conceptualise 'development' and its policies differently, placing more importance on the actual practices of development and their complexities:

> These contrasted instrumental and critical views have blocked the way for a more insightful ethnography of development capable of opening up the implementation black box so as to address the relationship between policy and practice. (...) My aim in this book is to reinstate the complex agency of actors in development at

---

[78] For a similar argument, but focusing on a successful, not a failing object, see Marianne De Laet and Annemarie Mol's study of a bush water pump (De Laet and Mol, 2000). In their analysis of *The Zimbabwe Bush Pump* De Laet and Mol explore how adaptation, reconfiguration and changeability can define a successful object. While staying identifiable as a pump, the object is adapted and changed by the inhabitants of the villages, where it has been installed. As de Laet and Mol argue the bush pump's strength is not primarily its translatability, but rather its fluidity.

> every level, and to move on from the image of duped perpetrators and victims caught up in a sort of 'space-age juggernaut on autopilot' (...) as well as to revise the false notion of all-powerful Western development institutions. (Mosse, 2005: 5-6)

James Scott in *Seeing like a State: How Certain Schemes to Improve the Human Condition Have Failed (1998)* also focuses on why development projects have failed. However, in distinction to Ferguson, his work emphasizes complexity and the importance of practices. He too develops a critique of development, but in a rather different vein. Scott argues that "thin simplifications" of complex systems fail to understand how human beings organize themselves, and so while plans are necessary and helpful, he shows how overarching, decentralized large-scale project plans often fail. These “thin simplifications” are explored in a diversity of case studies: failing relations between nature and society and resulting environmental damage, the social failure of a high-modernistic, scientific city, as well as failed agricultural collectivization in both Tanzania and the former Soviet Union. Scott argues that overarching, high-modernist planning projects fail because they are based on a deterministic and over-simplified view of society. He proposes a modest approach to planning, based on rules of thumb, small steps, and improvisation; an approach that is contingent, local, context-dependent, based on and working with situated practices.

Following Mosse and Scott's lead, my focus in this chapter is on the complexities of malaria policies, and the linkages between a variety of policy practices. The chapter, however, is not on why malaria control in Ghana fails. For one, because it does not fail. It sometimes works well, and then not so well, but it certainly does not fail. Inspired by the work of John Law (2004) and ethnographies of development (such as Scott, 1998; Mosse, 2005), attention in this chapter will be paid to practices and things that *escape* policies, things that don't seem

to fit or don't seem to matter to the problem in question. As we will see, this is an investigation into *logics, practices and interference*: public health logics rub up against postcolonial market logics, and both of those are challenged by a mosquitoes' logic.

Currently, within malaria control *public health* is the dominant logic informing policy interventions. This imagines malaria to be a disease that exists in the realm of health policies and practices. Malaria control is part of health care provision, and is derived from knowledge produced within the medical sciences. However, as we have already seen in the last two chapters, current interventions against malaria are not clinic-, or laboratory-bound, they rather emerge from diverse scientific domains as well as are connected to a variety of industry sectors. While focusing on one logic, certain practices become influential or 'common sense'. As we have seen in my brief introductory vignette others practices escape, are too small to be registered, to matter. Or to put it even more strongly they are marginalised, are a "hinterland" of dominant practices (Law, 2004a). Law points out that those "hinterlands" are always and necessarily there. Every successful practice, scientific method, tool or policy has a hinterland attached to it, hinterlands are "pre-existing social and material realities" (ibid: 13). And the dominant landscapes and their hinterlands have to be imagined not as structures but as "loosely coupled systems":

> This is the idea that what engineers call 'loosely coupled systems' are more robust than those that display a single and definite logic. Perhaps out-thereness resonates to produce dramatic patterns without single and definite structures at all. Perhaps things hold together precisely because they don't. (...) In which case the great inequalities and distributions might be better understood not as structures but as non-structures. And we will need, for better or for worse, to find

ways of exploring the partial overlaps of hinterlands, the manifest absences, if we want to get to grips with those inequalities. (ibid: 142)

I will in this chapter build on this idea. The chapter focuses on insecticide-treated bednets (ITNs), which has briefly been introduced as a tool of malaria control in *Chapter 4.3.2.* I will in the following explore three hinterlands of ITNs – economic marketing and distribution (*Section 7.2*), the ownership-usage gap (*Section 7.3*), and emerging resistance in mosquitoes (*Section 7.4*) – and relate those hinterlands to the dominant, or visible ITN policies and practices. I will trace how those practices that don't seem to matter to ITN policies, in fact interfere with them and create (or block) certain realities. I argue that excavating such 'escaping' practices might lead us to imagine malaria policies differently.

7.2 The good imperialists: Christmas, Capitalism and Christianity

1 Net. 10 Bucks. Save Lives (Spread the Net Campaign)

Send a Net. Save a Life. (Nothing but Nets Campaign)

Nets for Life. (Nets for Life Campaign)

ITNs are a popular charity item – one could say they are the international emblem of malaria charity. Seen from a marketing perspective bednets are a highly suitable charity object; one net can be delivered to a family in need for US$ 10, meaning with a small contribution people can have tangible effects and 'save a life' (Nothing but Nets, 2009). Hence, for instance on the web site 'World swim against malaria' 307,301 swimmers have raised US$ 2,068,317, of which 467,017 ITNs were purchased (http://www.worldswimagainstmalaria.com/sponsors.aspx). The Net-O-Meter of the organisation 'Nothing but Nets' announces it has raised money for 2, 623, 464 nets so far

(05/2009), and for World Malaria Day 2008 the UN Foundation and Nothing but Nets offered people to feel for yourself how bednet distribution works in Africa, by playing 'Deliver the net' before you contribute $$s to get your net out there: http://www.nothingbutnets.net/its-easy-to-help/game.html. Thus, private donations and ITNs work well together; people can give only a small amount and get a concrete result back. The connection between providing a bednet and saving a life is direct and compelling in its simplicity. Last Christmas for instance, UNICEF Canada run a 'Spread the Net' campaign, inter alia at Canadian universities: "This Christmas, for just 10 bucks you can buy perhaps the most gratifying present you'll ever give: an insecticide-treated mosquito bed-net that will save a vulnerable child's life in Africa" (SFU, 2008; UNICEF CA, 2008). In a long entangled history of religion and capital, the trinity of Christmas, Christianity and Capitalism catapults poor and suffering African children right under the Christmas tree. In this sense ITNs become a connector between a poor Africa and the rich West.

But not only on an individual level ITNs are popular; ITNs also appeal to more large-scale charity efforts. The variety of donors involved in ITN distribution testifies to these qualities: For initiatives such as the *Tony Blair Faith Foundation,* ITN distribution is an integral and important part of their charity work. For others it is the sole focus, as for the international business coalition *Nets For Life* – where amongst others *Coca Cola*, *Exxon Mobile* and *Standard Chartered Bank* work together with faith-based NGOs, such as the (US based) *Episcopal Relief and Development*. High profile politicians and celebrities are also fans of bednets. The seeming simplicity of its effectiveness is seductive, but sometimes such quickly made commitments can backfire: Sharon Stone famously challenged political leaders in a session on 'African poverty' at the *2005 World Economic Forum* in Davos to pledge US$1 million for bednets in Tanzania. She herself committed US$10,000 immediately, and managed to get the commitment for the million in 5 minutes. After the

conference though only US$250,000 of the sum materialised, and in the end UNICEF provided US$750,000 in order to fulfil Sharon Stone's promise to Tanzania.

Generally speaking, the non-governmental advocacy/charity sector has formed a close alliance with politicians and celebrities, and ITN charity flourishes – as one Ghanaian entomologist put it: "they are flooding Africa with bednets"[79]. But crucially, in the long run, these actors are also doing something else: They are creating a market. This is a market where multinational, capitalist business rules apply, albeit with its specific (development) industry relationships. For a start, in the ITN market big international donors are the buyers, not individual consumers. The dominant ITN procurement agency worldwide is UNICEF, basically the number one customer for ITN producers. The nets are mainly financed through country grants from the Global Fund or other donor agencies, such as the WorldBank's *Malaria Booster Program* or the British development agency DFID (see *Chapter 4* for more detail).

But not every ITN brand can be purchased by those donor agencies: The WHO via its *Pesticide Evaluation Scheme* (WHOPES) certifies ITN producers that adhere to their safety and quality standards (www.who.int/whopes). WHOPES "promotes and coordinates the testing and evaluation of pesticides for public health" (ibid), and the WHOPES recommendation system is linked to procurement. UN (related) organisations for instance will only be able to procure recommended nets. Moreover, (international) ITN producers have recently started to organise themselves – facilitated through the *Global Business Coalition* (GBC). As we can read in their last ITN report (GBC, 2009) the aim is to 'professionalize' donor and country practices. The report argues for "enhancing efficiency,

[79] More on the lack of reflection about what it might mean, entomologically, to flood Africa with bednets in *Section 7.4*.

transparency and accountability, industry action commitments, minimum standard procurement principles", and states:

> Accordingly, market stabilization and efficiency could be served by the minimum standards mentioned above. (...) For the malaria community to meet the end-2010 objectives and in general to ensure a transparent market, where good performance is rewarded and poor performance sanctioned, it is necessary to monitor parties involved in the process closely. (ibid:10)

They vote to adopt a "centralised procurement system" (ibid: 11), and "considering further incentives (...) that streamline procurement and direct payment to manufacturers" (ibid). Many buzzwords, and of course there is nothing to be said against efficient bidding, procurement and distribution procedures for ITNs. However, what is written between the lines here is that only companies, which have all such procedures and processes already in place, will have a chance to compete on the market, and crucially for the sought-after WHO recommendation[80]. In practice the WHOPES-procedure already excludes small (African) producers, not because their products are of lesser quality, but because most small companies are not able to afford the licensing process. The rules and regulations that the GBC proposes go much further, and would exclude local producers from the very start, only international players have the financial and logistical means to adhere to the proposed standards. A (subtle) way to monopolize a market through standardisation and quality assurance. As *NetMark* has put the problems for African manufacturers: "Many countries would like to develop their own net production capacity, however, net manufacturing

---

80 So far only two products have full endorsement Olyset (Sumitomo Chemicals) and Permanet (Vestergaard-Frandsen), several products have 'interim' status (see WHOPES, 2009 http://www.who.int/whopes/Long_lasting_insecticidal_nets_Aug09.pdf).

requires millions of dollars in investment in an area of high competition and low margins" (NetMark, undated).

Once ITNs are manufactured, the question is how one can bring ITNs successfully to the consumer? In Ghana the main actors with respect to ITN implementation are UNICEF and the Ghana Health Service, which runs a yearly free distribution of nets to vulnerable groups at the *National Integrated Maternal and Child Health Care Campaign*. The nets get donated from international donors, such as DFID, WorldBank, or the Japanese government. The Japanese contribution first startled me since I had not heard about Japanese involvement in malaria control in Ghana before. When I asked a representative of the NMCP about this, she said in a very matter of fact way, "it's because they have started to produce them", and tells me that there are three ITNs producers, who were licensed by the WHO at that time, of which the Japanese brand Olyset was the latest to obtain a license. The Japanese donation, thus, turned out to be marketing masked as a governmental donation in the name of global health and development aid.

Secondly, the social marketing organisation *NetMark* is working to implement ITNs in Ghana. NetMark aims to build a market for bednet sales and this, in the eyes of the NMCP, is valuable because it makes Ghana independent from international malaria policy and crucially donor decisions (Interview NMCP, 2007). However, many public health specialists argue that ITNs should be free and only distributed through public channels in order to ensure universal coverage and usage. For instance Teklehaimanot, Sachs and Curtis (2007a) argue in *The Lancet* that social marketing of ITNs has failed:

> Tragically, funds mobilised for malaria prevention and control are not used for saving lives, but are instead diverted to try to create new markets for bednets that

do not exist. This approach has compromised the effectiveness of malaria control efforts. We strongly suggest that malaria-endemic countries and donor agencies should abandon the idea of social marketing, especially in rural areas greatly affected by malaria, and also in urban areas with malaria transmission. (ibid: 2146)

They argue that no market for bednets exists; people are economically too poor for the nets and so in order to bring the nets to the people and have an effect on malaria cases, ITNs need to be free. The assertion that social marketing is trying to "create new markets for bednets that do not exist" is right in the sense that many people are not able to pay. However, it is also wrong, because actually those markets have already existed before social marketing or even before insecticide-treated donor nets, as an excerpt from my field diary shows:

February 2009, London

I meet my Ghanaian friend Daniel at the British Library for a coffee. As usual we start to talk about malaria. (...) After some time Daniel tells me a family story: He says his mother used to make bednets in Tamale and sell them there. It turns out that not only his mum was doing it, but also many other people in Tamale. This was a local business and well established, it had its own local economy. Daniel characterised the local economy to me as follows: The materials would arrive from Europe, together with used clothes. Netting material arrives in big bales, some of them were of bigger net structure, which was used for clothes and curtains. The ones with finer netting were used for mosquito nets. The material would go to a tailor, who sews nets out of the raw material. Daniel says that this tailoring branch had its very own characteristics, the tailors were usually men rather than women, who mostly do the clothes tailoring. And then the nets go to local distributors, either to people selling the

nets on the market, or to people, who would carry the nets into the rural areas, where they sell it to farmers. And this was not a small informal side income for some people, but was an established local economic production and trade network in its own right. The sales were good, albeit seasonal, especially high in the rainy and harvesting seasons, when mosquitoes are abundant and people also have money to buy the nets.

There is an irony arising here, when one considers that NetMark is working hard to build a market that already exists. However, at a second look the ITN market turns out to be two markets actually. NetMark works to integrate ITNs into the Ghanaian market, both bringing the price for ITNs down locally (through lower taxes, vouchers and more products in circulation), as well as an increase in consumption. NetMark aims to build a market for *imported ITNs* rather than working with the *informal sewing market* Daniel explained to me. Thus, existing local capacity is not relevant to NetMark, as can be seen in the results of their research on a local bednet economy:

> The availability of nets in Ghana is limited to those imported through informal channels from Nigeria, tailored locally from cloth or old net curtains as well as free standing infant nets from Asia. Other nets are being supplied locally to government hospitals and secondary schools on a limited basis through private sector sources. Nets are not widely available in the marketplace. (NetMark, 2000: 16)

Locally produced nets are listed under "limited to" rather as seen a market, which could be worked with, empowered or extended. Daniel's story enables another reading; he would argue that the ugly side-effect of the penetration of international ITNs into the Ghanaian market was that many local bednet producers lost their income – once again we can see an

erasing of local practices and networks in the name of development and public health. Do we still imagine Africa to be an empty continent, rich in resources but without valuable social structures, trade networks and economies? Dambisa Moyo (2009) would argue yes, we do. This is how she puts the connection between charity and the loss of local business:

> There's a mosquito net maker in Africa. He manufactures around 500 nets a week. He employs ten people, who (as with many African countries) each have to support upwards of fifteen relatives. However hard they work, they can't make enough nets to combat the malaria carrying mosquito. Enter vociferous Hollywood movie star who rallies the masses, and goads Western governments to collect and send 100,000 mosquito nets to the afflicted region, at a cost of a million dollars. The nets arrive, the nets are distributed, and a good 'deed' is done. With the market flooded with foreign nets, however, our mosquito net maker is promptly put out of business. His ten workers can no longer support their 150 dependants (who are now forced to depend on handouts), and one mustn't forget that in a maximum of five years the majority of the imported nets will be torn, damaged and of no further use. (ibid: 44)

Moyo's solutions to this dilemma are micro-credit initiatives that build on, and foster, local economic development (ibid: 130-1). This is a really important point, and something that is lacking not only when it comes to bednets but for many services on the African continent[81]. However, looking at the specifics of bednets and malaria control a little closer shows that this might be more complex than Moyo assumes. Firstly, bednets today are hi-tech products

---

[81] Despite a massive increase in Grameen style micro-credit initiatives over the last decade. The Grameen Bank was founded in 1983 in Bangladesh and achieved popularity in mainstream discourse the latest in 2006, when the founder of Grameen Bank, Muhammad Yunus, received the Nobel Peace Prize. The micro-finance industry has grown massively over the last two decades, never the less 'has yet to reach 5 per cent of the customers among the poor world' (Moyo, 2009: 132). Especially in the public health sector, community involvement and ownership in form of micro-credit projects are rare.

impregnated with insecticides. The newest version long-lasting insecticide-treated nets (LLINs) have insecticides woven into the fibres of the net, and the insecticide remains effective for the expected lifespan of the net, 4-5 years[82]. This not only renders manufacturing into an expensive, industrial process, but also makes it necessary to have security and quality standards for the use of insecticides. So, even if the donor community was ready to invest into local bednet production, it would not be possible to have ITN/LLINs produced in the way that Daniel's mum or Moyo's bed net producer have done it so far. The production of ITN/LLINs is factory-based, and involves much more than sewing of meshed materials into nets.

Most of the ITN/LLIN producers today do not manufacture on the African continent, *Sumitomo Chemicals* was the first ITN producer manufacturing in Africa. They have a manufacturing plant in Tanzania, opened a stitching factory in Ethiopia in June 2009, and plan to open more stitching factories in Malawi and Uganda[83]. *Sumitomo* is committed to manufacturing in Africa and advertises their nets as "Made in Africa, by Africans, for Africans" – 'owned by Japanese' one wants to add though. Their biggest competitor *Vestergaard-Frandsen*, produces its *Permanet* in Vietnam and Thailand. Probably, Dambisa Moyo would buy the *Olyset* net by *Sumitomo*, even if this is not the decentralised micro-credit industry she envisioned for her bednet producer, it still creates an industry on the African continent hat in her opinion is urgently needed to overcome Africa's aid dilemma (Moyo 2009)[84].

---

[82] And thus do not need to be re-treated regularly with insecticides as ITNs require. ITNs are recommended to be re-treated every 6 months to a year.

[83] Note that all the factories are based in East Africa, albeit the highest malaria burden is in Central and West Africa.

[84] I take here a very particular micro-aspect of Moyo's book, her case study of a mosquito net producer. The general argument of her book is very contested: she argues that we should cut of all aid to Africa in five years, to put it briefly 'leave Africa alone, and let free market and microcredits rule'. This contrasts sharply with the other economist that has been quoted in this chapter: Jeffery Sachs, who in his approach to development relies on fostering change from within the donor system. Both approaches have deep flaws; Sachs for instance has been critiqued as naïve, while Moyo is portrayed as problematically neo-liberal. There has been an intensive debate between Sachs, Moyo and William Easterley (who supports Moyo's argument). See here for instance for a summary of Sachs position: http://www.huffingtonpost.com/jeffrey-sachs/aid-ironies_b_207181.html. More nuanced approaches to aid, development and its problems come from critical development studies, for a discussion of moyo's book and the debate see for

Secondly, when thinking through the postcolonial politics of bednets and the prevention of malaria, what also needs to be taken into account is the availability of nets for people in need. Accordingly, one of my field work encounters in the rural village Ananekrom complicates the debate further:

I recall a conversation with a man yesterday evening, when I ventured out of the compound and went for a walk through 'town'. The man approached me, clearly eager to try out his English, which was very good for local standards. It was very good despite him not having a lot of practice, as I discover, because he tells me that he was very good at English in school, but then had to stop going to school because his father died and he had to take care of the family. He is now a farmer in a close by village and tells me that poverty is the problem here. Because of this, he says, women get pregnant too early and then stop education. He also tells me that mosquitoes are a problem and that he went to the local health centre to buy a mosquito net, but that they have 'too many rules' there[85]*. Only his wife would have been able to buy a mosquito net, and only if she is pregnant. I asked him if there is a place where one can buy nets in Ananekrom, he said 'no' and that he just wants his wife and children to sleep under nets – to be safe, he adds – but that 'even when you bring the money to buy a net, they won't give it to you'. While we were talking I was thinking about the complicated subsidy system that Ghana has for nets and tried to explain to him that nets are subsidised for pregnant women and women with small children, that they only cost 2 GHC then, but that normally nets are very expensive, around 10 GHC. He listens but then comes back to what he was saying before: 'too many rules'. I agree, if he is ready to invest his precious money, or even save money for a net, he should really be able to get one. But how to do*

---

instance here: http://humanitarianismafrica.typepad.com/my_weblog/2010/08/the-great-aid-debate.html. Despite this controversy Moyo's thoughts on the bed net production are helpful and, I believe, worth discussing in conjunction with my field material.

[85] He mentions mosquitoes without me telling him on what I am working, but he might have gotten this information from other people in the village.

this? All of a sudden I find myself thinking about David, the country manager of NetMark, and about possibilities to get a NetMark store to Ananekrom – a store of whose market philosophy I was skeptical all the way long.

Nets are, thus, not available anywhere and to everyone, who is willing to buy a net. Thus, while I agree with Teklehaimanot et al. in principle and would argue for free bednets instead of building a market, in practice their argument has two problems. Firstly, it overlooks the post/neocolonial dimensions of the debate. It definitely is valuable from a Ghanaian perspective to be able to build structures that will make the country more independent in its decisions[86]. Secondly, Teklehaimanot et al. assume that there is enough money and political will to sustain the funds needed to provide every one of the billion people living on the African continent, not withstanding people in malaria risk areas in Asia and Southern America, with ITNs. In a different paper Teklehaimanot, Cord and Sachs (2007b) calculated that "the cost of comprehensive malaria control for Africa is US$ 3.0 billion per year on average, or around US$ 4.02 per African at risk" (2007b:138). However, pledges to the Global Fund (the largest provider of resources for malaria control in Africa) by 2010 are US$3 billion in total per year of an estimated 15 billion per year that would be needed to prevent and treat HIV, tuberculosis and malaria (see GATMF webpage: http://www.theglobalfund.org/en/mobilization/?lang=en). These figures are far away from the needed resources, which is feared to be only exacerbated by the current economic crisis[87].

Thus, Dambisa Moyo does have a point when she argues that we need to work with (and not parallel to) existing structures if we are to enable economic development in sub-Saharan Africa. She is also right that in bednet policies today international markets get prioritised

---

[86] Such reasoning was employed by the Ghanaian government in the decision to implement with artesunate-amodiaquine a combination-drug that can (at least partly) be manufactured locally, and is relevant for ITN debates as well.

[87] This concern for instance led the current executive director to call for a broadening of the donor basis to the G20 states (many of which themselves are recipients of GF grants) See http://www.malariafreefuture.org/blog/?p=728, http://www.reuters.com/article/asiaCrisis/idUSHKG74394.

over local development[88]. And, as we have seen above, public health concerns are employed to justify such politics. Thus, in the creation of a bednet market the rhetoric of public health need, charity and efficiency come together. But postcolonial politics, the logics of public health and the politics of markets also clash or interfere with each other. International donor initiatives to deliver insecticide-treated bednets to people at the risk of malaria marginalize local economies of bednets, and put people out of work by creating a second market structure that competes with older ways of organising bednet purchase and delivery. However, those different logics do not clash in the open, postcolonial politics do not seem to make a difference to debates on ITN policies. They are not visible in public health discourses, policies and regulations – they escape. Gayatri Spivak would call the escape of postcolonial politics from bednet implementation the politics of the "good imperialists"[89]. And Michel Callon has conceptualised such practices as "bracketing off" through economic calculations:

> The different anthropological programs developed – sometimes concurrently but very often in a convergent way – by economics at large and in particular by the different professionals and experts who equip markets, tend to overlook inequalities in calculating equipment and even more frequently are actually busy trying to produce such inequalities. They likewise disregard or even worse promote the fact that the organization of encounters, for instance between buyers and suppliers, directs badly-equipped agencies towards well-equipped ones. In the bracketing off of these issues, economics particularly in its most abstract and

---

88 A similar argument can be made about drug policies. As one of my interview partners, a pharmacist devoted to building local, decentralised pharmaceutical capacity in Africa has put it: "You can see it with the fixed dose combination, artesunate and amodiaquine. You see, Sanofi make it in a way so that you have to use this fixed dose combination. They say that otherwise it wouldn't work and all malaria patients would die. Is that true? First it's not true. Second it's not fair. Because they are the only one, they are the only one who is pre-qualified by WHO. And then GF will have to use their products. So you tie people's hands all the time, like this. And I feel this is so cruel. So it's apartheid, really. Because, first, the poor can't afford to buy. Second, even if they can manufacture they are not pre-qualified, so how can you use GF money to buy these products? You can't, and so you force the poor countries in a way not to be able to access this drug". (Interview, 2007)

89 Gaytri Spivak at a public lecture in Durham, September 2007

> formal parts has played and still does play a decisive role in producing and reproducing inequalities. (Callon, 2007: 48-49)

Following Callon, abstract practices of calculation that target sheer efficiency are to be understood performatively, and are generative not only of economic conditions, but also of broader societal inequalities. In this section I have proposed that the postcolonial politics of bednet markets escape public health policies on ITNs and their implementation. I will discuss this and other escaping logics, as well as their clashes in *Section 7.5*. The next section of this chapter focuses on another important element that escape current policies: ITNs do not only have to be distributed to the target households, but in order to be effective they also have to be used. A simple point, which, however, is an issue of growing importance in practice, called 'net ownership-usage gap' (WHO).

7.3 "After all, everyone in Ananekrom gets bitten by the mosquito! Why then do some get malaria and others don't?"

In order to document successful interventions, the usage of ITNs is monitored and one sentence has become the gold standard of ITN monitoring: "Has your child slept under a bed net last night?" This question has variations and gets supplemented with more in-depth questions in some surveys. But it is, nonetheless, the core of ITN monitoring. For instance, comprehensive health surveys such as the *Democratic and Health Survey* (DHS), or the *Multiple Indicator Cluster Survey* (MICS) both use this phrase; and the data collected for those surveys are the basis of the major global health indicators in developing countries. Inter alia the WHO's *World malaria report* (2008) data on ITN usage (see WHO, 2008, Annex 6) is made up of data from DHS and MICS. Furthermore, the RBM partners developed a *Malaria Indicator Survey* (MIS). An important part of this a household survey is

bednet usage. Here, it is also variations of the core question that get asked, albeit more in-depth than in other surveys.

The resulting categories of an UNICEF MISC survey (UNICEF, 2007) conducted in Ghana look as follows:

Table CH.11: Children sleeping under bednets

Percentage of children aged 0-59 months who slept under an insecticide treated net(ITN) during the previous night, Ghana, 2006

	Slept under a bednet *	Sleep under an ITN**	Slept under an untreated net	Slept under a net but don't know if treated	Don't know if slept under a net	Did not sleep under a bednet	Number of children aged 0-59 months
Sex							
Male	33.3	11.3	10.3	2.5	1.0	58.5	1,789
Female	31.8	21.6	11.3	0.4	0.2	68.0	1,678
Region							
Western	15.0	11.5	3.2	0.3	0.7	84.3	347
Central	25.8	19.8	6.0	0.0	1.0	73.2	302
Greater Accra	24.2	16.3	6.7	1.2	0.0	75.8	448
Volta	54.2	21.5	30.0	2.7	0.0	45.8	261
Eastern	32.2	24.9	6.7	0.5	0.0	67.8	463
Ashanti	26.5	21.8	4.2	0.5	0.2	73.3	506
Brong Ahafo	39.3	25.7	13.6	0.0	0.0	60.7	311
Northern	36.7	21.9	14.4	0.4	0.0	63.3	579
Upper East	51.5	39.3	11.3	0.9	0.2	48.2	146
Upper West	55.0	37.1	16.3	1.5	0.0	45.0	105
Area							
Urban	22.4	16.4	5.4	0.6	0.2	77.5	1,236
Rural	38.3	24.8	12.7	0.7	0.2	61.5	2,231
Age							
0-11 months	37.9	27.8	9.3	0.9	0.0	62.1	715
12-23 months	36.2	24.5	10.9	0.8	0.3	63.5	706
24-35 months	31.3	19.6	11.0	0.8	0.2	68.5	667
36-47 months	29.9	20.6	8.9	0.4	0.3	69.8	718
48-59 months	27.3	16.3	10.5	0.5	0.2	72.5	661
Wealth index quintiles							
Poorest	41.4	24.4	16.4	0.7	0.0	58.5	786
Second	34.5	22.2	11.9	0.5	0.4	65.1	830
Middle	29.0	19.2	9.3	0.5	0.3	70.7	684
Fourth	29.0	20.8	6.7	1.5	0.0	71.0	623
Richest	25.7	22.2	3.3	0.2	0.2	74.1	544
Total	**32.6**	**21.8**	**10.1**	**0.7**	**0.2**	**67.2**	**3,467**

*MICS indicator 38

**MICS indicator 37; MDG indicator 22

Figure 14: Monitoring the Situation of Children and Women, MICS Ghana, 2006 (UNICEF, 2007:13)

Such attempts at monitoring provide a rough idea of how many bednets are in the households and used. However (and as I'm sure the designers of such surveys are aware too), it is important to not over-estimate the accuracy of such data. People are well aware that if they had been given a bednet for free, they better reply that they are using it. In

psychology the effect of giving an (incorrect) answer that people perceive as wanted/expected is called 'social desirability'. To avoid such corruption of data, interviewers are encouraged to ask the people if they can see the mounted bednets in peoples' houses[90]. As we can see from UNICEF's data the usage numbers of ITNs is still low in Ghana, in 2006 more than half, namely 67% of Ghanaian children (aged 0-59 months), reportedly did *not* sleep under a bednet. And this is not only a question of having access and the means to buy a net or not, if one asks people why bednets are not used frequently, the answers become too complicated to be captured by a survey.

Firstly, there is a gap between urban and rural livelihoods, which is reflected in diverging bednet usage. As Agyepong and Manderson (1999) show in their study, where they compare a rural area in the Eastern Region in Ghana with a neighbourhood in Accra:

> Although bed nets are expensive and incomes low in rural areas, ownership was, as noted, near universal, and in any house, two or three nets might be mounted to the wall or a ceiling beam, depending on the number of householders and the sleeping arrangements within the house. In interviews, women told us that as soon as a young girl began to earn money, she would plan to buy her own bed net. (ibid: 88/9)

> Conversely, failure to use (or own) bed nets relates not necessarily or directly to an association between the vector and disease; the decision regarding the method used to avoid mosquito bites appears to be influenced by people's own

[90] These inspections obviously have a disciplinary character that deserves much more attention. I cannot do this at this stage. However, I would also like to point out that we have to keep the difference in architecture and housing into account when judging this practise. Houses in hot climates, like Ghana, are traditionally much more porous and open than in Northern houses. The Ghanaian kitchen is traditionally outside and people often live in housing clusters, compounds, that are open not only to an extended family, but often more broadly to the community. Thus, privacy has to be interpreted differently in this context too. It was not part of my study, and so I cannot draw on data here, but one could speculate that most people would not perceive people coming into their rooms and checking for bednets as problematic as such. But this would need much more empirical and analytic attention.

experience of period of exposure – that is, on the basis of practical reason. Rural dwellers tended to use bed nets to ensure they slept, when mosquitoes were active during sleeping hours. (...) In urban Accra, people claimed to reject nets because of the cost, but in fact used coils and repellents in the early evening when nuisance mosquitoes were most dense. (ibid: 90)

As Agyepong and Manderson elaborate, rural and urban bednet stories differ from each other in complex ways. There is no linear relationship between knowledge and practice, people tend to use bednets to ensure sound sleep, not primarily as disease prevention. Conversely, people, who do not use bednets, might well use other means to avoid getting bitten. Group discussions we[91] conducted with rural inhabitants in Ananekrom, a village in the Ashanti Akim-North district, also underlined that the connection between bednet usage and malaria is weak. However, the issues with ITNs cut even deeper – as two of my colleagues have put it nicely in our joined analysis of the group discussion results:

Indeed, malaria (popularly known as fever) does not convey a singular meaning and cause. This came to light in Ananekrom as some participants in the workshop did not see the mosquito as the sole cause of malaria but rather as a complementary cause. They said: "After all, every one in Ananekrom gets bitten by the mosquito! Why then do some get malaria and others don't?" It is therefore important to note the differences in the understanding of the disease between policy makers/elite and the ordinary illiterate in Ananekrom in the design and implementation of malarial control/prevention programmes in Ghana. (Ganle Kuumuori, 2008)

---

[91] The group discussions were a part of a two week workshop – collaboration between the Geography Department of KNUST in Kumasi and me. I thank Martin Agyemang, Benedicta Asante, Ganle John Kuumuori, Enoch Assan Ninson and Regina Penrose, who conducted the workshops and analysis with me and without whom the workshop would have been impossible!

Such reasoning from "the ordinary illiterate", as Ganle puts it, could of course be dismissed as ignorance, lack in formal education etc, but this does not do justice to what is going on – as another workshop facilitator, Martin, points out:

One man among the opinion leaders present for the workshop said "everyone is bitten by mosquitoes day in day out but those, who are more likely to get malaria, are those who eat a lot of oily food and stay in the sun for longer hours". Among the pregnant women, there was a wide range of causes for malaria which included mosquitoes, unkempt environment, staying in the sun for long hours, drinking dirty water (from stagnant source), eating a lot of oily food such as groundnut, eating excess sugar, houseflies and working around fire. (...) And you know it is quite interesting when the man also said that you know "everybody is bitten by a mosquito one way or the other, but it when you stand in the sun to work and you eat fatty-oil and fatty food that causes the malaria to express itself in the human body", because everybody is virtually bitten by a mosquito a everyday. I think it was quite interesting. (Martin Agyemang 2008)

What Martin suggests is "interesting", namely that not everyone who is in contact with infected mosquitoes develops malaria, is also of interest to biomedical research on malaria. Notwithstanding much research on the topic, the concrete factors that make an individual vulnerable to developing malaria in a body are still unclear and a topic of scientific studies (Marsh, 1992; 2010). We know that people, who have never lived through a malaria infection are more vulnerable, we know that the immunity to malaria a body can develop is only partial, and further that this immunity is particular to subspecies of the plasmodium parasite and thereby local. We know that humans loose this partial immunity after not being exposed for some time. Haemoglobin variations (most prominently sickle-cell anaemia) and other genetic polymorphisms have been explained in terms of an adaptation to malaria

(mainly based on their biological mechanism, and the correlation of occurrence and malaria prevalence). The development of general anaemia and malaria are also assumed to be entangled, and the development of Burkitt's lymphoma is arguably due to an interaction between plasmodium falciparum and the Epstein-Barr virus (all: Marsh 2002: 252-67).

So disease interactions and adaptations are manifold but what remains unclear is which factors *exactly* make a human body vulnerable to malaria, or protect one against it. An unhealthy diet (eating too much sugar or fatty oils), or a weakened immune system (standing too long in the sun, being close to breeding places) can well be factors contributing to someone's vulnerability to malaria. These are triggers of malaria that people observe in their bodies, their lives, their practices. And such observations are the reason why people do not believe in the simple story that bednet distributors reduce their marketing to. Malaria gets transmitted by mosquitoes, but is not only caused by mosquitoes and the presence of parasites in the blood: Current research in Ghana has found that 58% of the population had parasites in their body; people routinely get bitten by mosquitoes and co-habit with parasites without getting ill (Owusu-Agyei et al., 2009). Thus, malaria lingers in our bodies, but is caused by a failing immune reaction in your body, its **expression** in the body as a disease is caused by a complex chain of factors.

Thus, we can say that the standard monitoring practices of ITNs only cover the tip of the iceberg. Underlying issues about why people do or don't use nets are not covered by the evaluation. Furthermore, "possession and appropriate use of ITNs do not automatically go hand-in-hand (...) many people who received the ITNs did not sleep under them, re-sold them, reduced their efficacy through inappropriate washing practices, or failed to replace them when damaged or torn" (WHO, 2007: 5). Bednets have been reported to be used for fishing (Minakawa et al. 2008), or have been transformed into wedding dresses (Odeke,

BBC World 2005[92]). In Ananekrom one family told me that they own two bednets, but only use one. The father, who sleeps on the floor does not use the second net, while the mother and children sleep under a net. When I asked why the father is not using the second net, the woman replied that they want to keep it for visitors. WHO too acknowledges the relevance of such 'cultural factors':

> The cultural factors that determine ITN, including LLIN, ownership, retention and use must be taken into consideration to ensure that communication and advocacy activities contribute to effective use of LLINs. In this context, research into local perceptions of mosquitoes, malaria, ITNs/LLINs and washing practices needs to be undertaken to determine the choice of media, messages and advocacy strategies. The ultimate aim should include measurement of increased ITN/LLIN awareness and reported changes in ITN/LLIN retention and use. (WHO, 2007: 8)

The policy-way to deal with cultural factors is, thus, to conduct research and as a result step up the media and advocacy campaign. It is not, however, to rethink if bednets are an appropriate strategy, or to involve the people concerned in a more quintessential way. This reinforces the understanding of bednets as an object that can be reduced to its numeric value. In their study of the HIV pre-exposure prophylactic pill, PrEP Rosengarten and Michael (2009) argue that through "abstracting out the 'messiness'" of everyday life and history, the pill is established as a quantitative object:

> Importantly, the achievement of 'quantification' is not just driven by a scientific rationale that enacts the epidemic as comprised of two actors:

---

92 For a photographic collection of "creative mis-uses" of bednets see: http://www.malariafreefuture.org/blog/?p=1005

fallible embodied subjects and lethal virus requiring mediation by a biomedical object and in this instance, a pill. It is also driven by a type of historical amnesia that fails to take into account, and potentially work with, the historical contingencies active in the everyday local relations of PrEP. That is, by abstracting out the 'messiness' –the outside of science—it does *not deal with what affects* the occurrence of infections. (ibid: 5)

In this vein I would like to argue bednets can also be understood as quantitative *objects*, their value gets created through scientific and monitoring practices. Bednets are objects that prevent malaria, objects that get distributed and whose numbers in households can be counted. However, bednets are not established as objects that get *used,* the messiness coming with usage is abstracted out. By reducing the bednet value to the numeric, and the challenge that implementation poses to education, bednets loose their qualitative character, and herewith their connection to practices of use or non-use. And, paradoxically this happens especially through policy assertions that acknowledge the cultural factors involved in bednet use as an educational challenge. This only serves to re-inscribe the quantitative character of the bednets instead of establishing a connection between peoples' (or users) practices, context and beliefs and the adequacy of the net. In "Seeing like a Survey" (2009) Law describes such practices as the "hinterland" of the survey, and argues as follows:

If we were being conventional we might say that this is bad social science. But I do not think it is quite as simple as that. So how about this as a first attempt at a performative alternative? Eurobarometer is creating a reality *but only in the context of its own interviews*. In these it is indeed real. But this is a reality that links poorly with other animal-consumer-reality-practices, or at least some of

> them. If it did this better then there would be a network-hinterland of practices working with more or less the same consumer in other places. (Law, 2009: 245)

In this sense, UNICEF monitoring catches and performs one reality of nets, the establishment of a quantitative bednet. Nevertheless, the "network-hinterland of such practices" is vast, as we have seen crucially includes peoples' experiences, livelihoods and related practices as well as opinions. For instance, the effectiveness and usage of ITNs varies from rural to urban Ghana, depends on when people go to bed (which in turn is influenced by the availability of electricity) and on what role people ascribe to mosquitoes in the causation and development of malaria or fever. Importantly, however, the effectivity of bednets depends on mosquitoes, their behaviour and habitats. This will be explored in the next section.

7.4 *Flooding Africa with bednets* – the entomology of ITNs

As we have seen in earlier sections, ITNs are not only a highly effective intervention against malaria (Binka, 1998; Killeen et al., 2006), but also popular with aid and donor agencies. However, seen from an entomologist's world the debate *does not stop at implementation* politics or the ownership-usage gap, but needs another, more subtle future perspective too – as one of my interviewees' put it:

> If one manipulates something in an ecosystem, something else will change too. This is competition, the mosquitoes need their blood meal, they will react. So, for example, with the flooding of bed nets into Africa, one needs to ask, what does the mosquito do? One needs to look at the mosquitoes perspective on bed nets. They don't get their blood meal, if we are lucky and there are enough cows or other animals around, they might start biting those. If we are unlucky, they might

> just start biting earlier, at around 6pm for example, then the bed nets don't help that much anymore. We need to pay attention to these subtle things. (Daniel Boakye, Noguchi Institute, Accra)

The female *Anopheles* mosquito needs blood to nurture her eggs – human blood is a means for the mosquito to secure offspring and the future of its species. So, not only for humans the stakes are high. ITNs kill and repel mosquitoes, the nets establish a physical barrier between mosquitoes and blood, and so threaten species survival. Thus, as my interview partner points out mosquitoes do not have much choice, they have to react to ITNs, else they would die out. There are two main adaptations; one is a behavioural reaction, such as changes in biting times or in the choice of host, as Daniel Boakye points out in the quotation above. I will discuss these potential *behavioural* adaptations to ITNs later, but firstly draw attention to another adaptation – *bodily* insecticide tolerance in mosquitoes.

Mosquitoes in malaria control are today mainly tamed through insecticides – be it via indoor residual spraying (as explored in *Chapter 5*) or through insecticide-treated bednets (ITNs). Insecticides work by killing and/or repelling mosquitoes. However, the repertoire of insecticides that are both effective and toxicologically safe is limited. For ITNs only pyrethroids are recommended (Enayati and Hemingway, 2010), while for IRS 12 insecticides from 4 classes are recommended (WHO IRS, 2006: 6), out of which *DDT*, *malathion* and one pyrethroid *Deltamethrin* (in this order) are the most cost-effective (Sadasivaiah et al. 2007: 254).

And here the problem comes in. The four classes of insecticides target in total only two neurological sites (Brooke, 2008). DDT and pyrethroids share the same mode of action on the mosquitoes' nervous system; they target the neuronal voltage-gated sodium ion

channels (Santolamazza et al., 2008; Enayati and Hemingway, 2010). Unsurprisingly, the resulting genetic mutations that make mosquitoes tolerant of the insecticides are similar. Resistance to DDT also conveys resistance to pyrethroids and vice versa, a phenomenon called cross-resistance. And thus, "once a 'resistance crisis' occurs, where disease control fails because mosquito evolution has rendered an insecticide ineffective, options are few, not least because of the very limited insecticide arsenal available" (Read et al, 2009:1).

Such mutations in mosquitoes are scientifically known as knockdown resistance (*kdr*). Knockdown resistance means that mosquitoes are literally not knocked down i.e. killed anymore, or at least not as quickly as considered 'usual' when exposed to the insecticide in question. Pyrethroid resistance had already been reported from West Africa before the broad introduction of ITNs – for instance from several parts of Côte d'Ivoire since 1993 (Tia et al, 2006) and Benin (Akogbéto et al, 1999). Today, pyrethroid resistance is widespread in West Africa and on the increase in Eastern and Southern Africa. It is presumed that *kdr* mainly originated in West Africa because of the long-standing widespread insecticide spraying – against malaria, but more importantly for agricultural use on cotton and cocoa plantations in the region. DDT and pyrethroids were both popular insecticides used in the 1960-70s on those plantations (Pinto et al, 2007; Boakye, Interview 2008). The regional history of agricultural and vector control practices is, thus, inscribed in the mosquitoes' collective memory, its genome.

Until today, two major African *kdr* mutations exist, and both primarily confer high DDT and low pyrethroid resistance (Enayati and Hemingway, 2010: 579). And those mutations are present in a big part of the mosquito populations. For instance, in one study with *Anopheles gambiae* (the main malaria vector in sub-Saharan Africa) the *kdr* genotype was detected in more than 98% of the specimens (Santolamazza et al., 2008:8). The so called 'operational

effects' on ITNs are, however, unclear. In Benin the effectivity of ITNs were found to be compromised by 70% in an area with pyrethroid-resistant mosquitoes (N'Guessan et al, 2007). However, other studies by Darriet et al. (2000) and Asidi et al. (2004, 2005) showed that ITNs retained their effectiveness despite frequent detection of *kdr* in *Anopheles gambiae* mosquitoes. Generally however, such results are of limited predictability, because mosquito evolution can happen quickly:

> The conundrum of *kdr* and phenotypic expression should be placed in the broader context of insecticide resistance and malaria control. This is because the development of cross-resistance between insecticide classes and incidences of multiple insecticide resistance phenotypes in vector populations have enormous potential to interfere with insecticide-based vector control efforts. (...) This scenario, coupled with a high rate of generation turnover and associated genetic recombination, means that insecticide resistance can arise rapidly in vector populations under intense insecticide selection pressure. (Brooke, 2008: 225)

So far, from the North of Ghana no *kdr* mutations have been reported for *Anopheles gambiae* (Anto et al, 2009). In a study in Obuasi, middle Ghana, *Anopheles funestus* showed resistance to DDT and pyrethroids, which "hints at the possibility of cross-resistance" (Okoye et al, 2008: 596). In an earlier study from Obuasi, DDT and pyrethroid resistance was detected in *Anopheles gambiae* (Coetzee et al, 2006). Agricultural insecticide usage presumably plays an important role in these developments. While some cotton is grown in Ghana (mainly in the North), cocoa production is of greater national importance. In the 1960s Ghana was the largest cocoa producer worldwide, and while today Ghana's neighbour Côte d'Ivoire has taken over this title, cocoa remains the most important

crop in the country's agricultural sector, particular in the forest areas in middle Ghana. Pest control through insecticide spraying with DDT has been officially banned in Ghana since 1985 (EPA, 2007). As a result of the DDT ban pyrethroids –including *deltamethrin*, the insecticide used for ITNs– gained importance in the Ghanaian cocoa pest control in the 1980s, and remain in use until today (Bateman, 2008). Thus, insects not only come into contact with pyrethroids through ITNs but also through agricultural spraying. [The increase of insecticide spraying by the in *Chapter 6* described IRS project will exacerbate this, even though the project has so far mainly relied on *malathion*, which belongs to a different class of insecticides.] Ultimately, resistance and cross-resistance will have an operational effect on ITNs, the question is just when and how?

Secondly, mosquitoes cannot only develop a bodily tolerance to insecticidal toxins, but also evade human interventions with ITNs in other ways. Mosquitoes might change their behavioural patterns in order to get access to their blood meal despite the prevalence of ITNs. As a precursor to this section it is important to point out that behavioural adaptations are called 'behavioural' because those are changes that can be read from mosquitoes' behaviour, their actions. Mostly, such changes will, however, not be *learned* behaviour from *one* mosquito. Such changes rather get passed on over generations, and are detectable for scientists in genomic changes of sub-populations. Mosquitoes with slightly different biting habits, i.e. the ones that bite earlier, have a survival advantage and can broaden their ecological niche. So more mosquitoes with earlier biting cycles will survive, and develop dominant traits, which ultimately leads to population changes. This makes it sound a slow process; however, with a mosquito life expectancy of 10-20 days generation turnover in mosquitoes is fast. Behavioural changes are changes in a habitat, which are inscribed in the genome of the swarm, not changes in individuals. Thus, in judging the effectiveness of ITNs

one needs to remember that mosquitoes' operational unit is generally the swarm, not Kant's rational subject.

The Ghanaian entomologist Daniel Boakye says "if we are lucky and there are enough cows or other animals around, they might start biting those". Cattle ownership has indeed been associated with reduced malaria risk in Zambia (Bulterys et al., 2009), and it has been found that agricultural practices have significant influence on distribution and blood feeding behaviour (Muturi et al., 2009). However, Pates and Curtis state that "highly anthropophilic species refuse to be diverted from humans, and the human blood index remains high even when almost everyone in a village is using a treated net" (Pates and Curtis, 2005: 60); and unfortunately it seems *Anopheles gambiae* expresses highly anthropophilic traits (Killeen, 2007).

Be that as it may, not many Ghanians live close to cattle anyway. Allegedly, another mosquito –the tsetse fly and associated (human and animal) trypanosomiasis– is responsible for the rather small cattle prevalence in the forest regions of Ghana (Clark, 1994). "In 1989 there were an estimated 1.2 million cattle, 2.2 million sheep, 2 million goats, 550,000 pigs, and 8 million chickens in Ghana" (ibid). In contrast there are approximately 24 million people in Ghana. So, unless mosquitoes fancy chicken, which are around Ghanaian homesteads in villages and cities alike, the diversion hypothesis might not work that well. Furthermore, interactions between mosquito and human ecologies are complex, and a neglected research area:

> The understandable focus of medical entomology upon processes directly associated with pathogen transmission have left major gaps in our knowledge of other crucial aspects of malaria vector ecology. Even field sampling methods for

malaria vectors seeking resources other than blood remain grossly underdeveloped so these aspects of the mosquito life cycle remain poorly understood. As a result, ecological determinants of success for existing and novel interventions can only be guessed at using simulations for which no field-derived parameters are available. (Killeen et al., 2010: 23, unpublished funding proposal)

And potential socio-ecological determinants vary greatly and are complexly linked with each other. Killeen et al. sum up the main ones in this impressive schema:

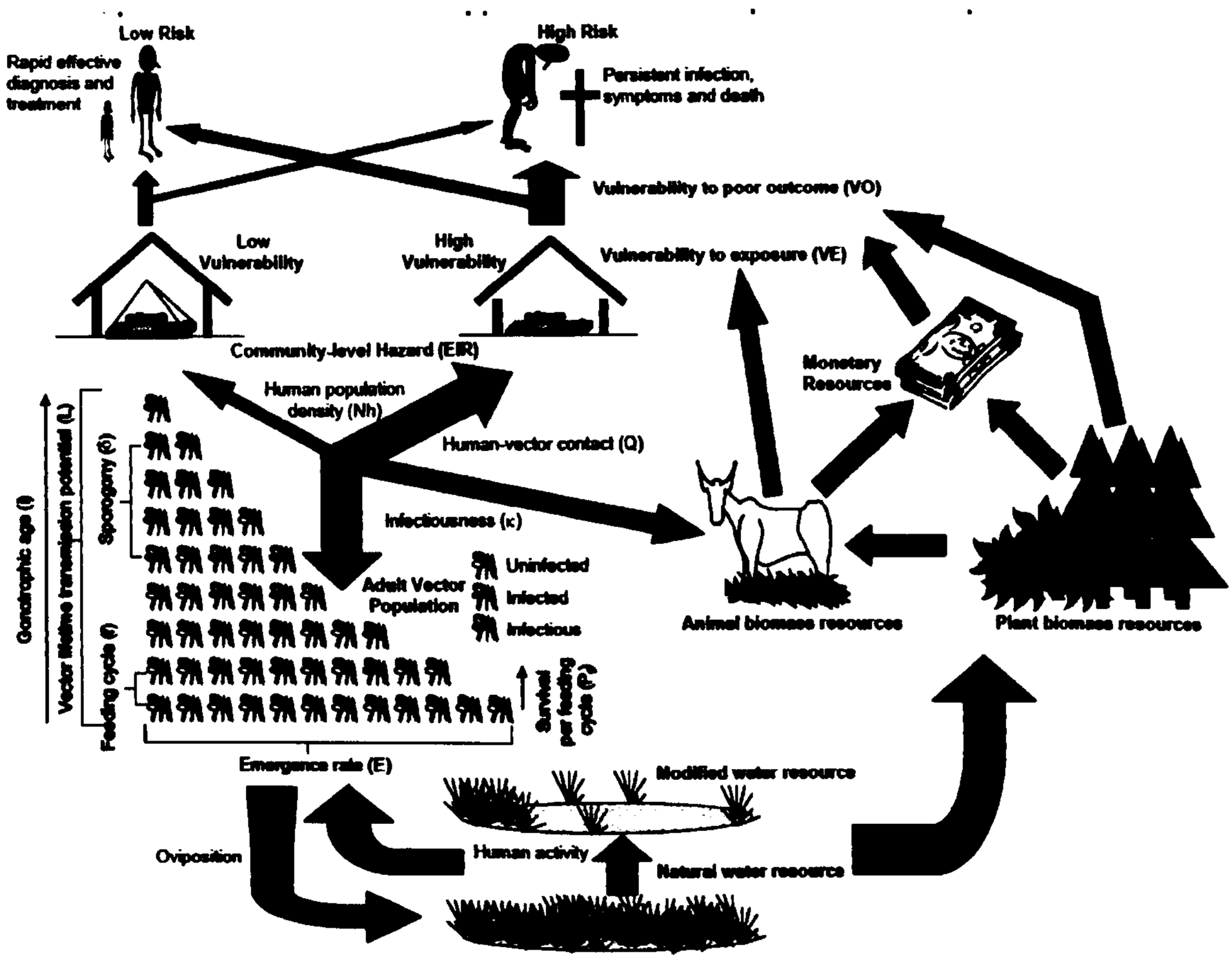


Figure 12: Resource utilization interactions between mosquitoes and humans.

Figure 15: Resource utilization interactions between mosquitoes and humans (Killeen et al, 2010: 25)

We can see that the factors influencing malaria prevalence are diverse and that human livelihoods and practices are interwoven with mosquitoes' ecologies. Maxwell Appawu,

another Ghanaian entomologist I spoke to, is concerned about a potential adaptation of mosquitoes which is not depicted in Killeen's scheme. And this is a change in the biting cycle of mosquitoes: Maxwell Appawu observed that the biting cycle has changed a bit in the North of Ghana. While in the South mosquito bites peak at 10pm and between 12pm-1am, in the North there seems to be a third peak developing, between 5-6am. And Maxwell reports that worryingly those were the mosquitoes with the highest parasite loads. To him this is "very scary" as it means that the use of bednets is already compromised, because people in villages will be up and out of the bednet's protective space by 5-6am. And the area where Maxwell and his team have done this work is the region around Navrongo, where also the first ITNs trials in Ghana happened (Binka et al, 1998). So Maxwell speculates that those mosquitoes that started biting between 5-6am might have already adapted to ITNs. In order to prove this hypothesis the team from the Noguchi Research Institute is currently doing some work in the neighbouring district, where fewer ITNs can be found. They then hope to compare the data sets and have more conclusive evidence about the changes in biting cycles and ITNs.

Klingenberg et al. in another study from Ghana fear that *Anopheline* in cities may be in the process of adapting to more polluted larval habitats, and are becoming more exophilic than in rural settings (Klinkenberg et al, 09:7). Many scenarios are possible, only one thing is certain – in the words of Professor Boakye again:

Mosquitoes will adapt to whatever the human will do. And only a few surviving mosquitoes are enough. Mosquitoes produce up to 1,000 eggs per month. So, if only a few survive and lay, let's say, 50 eggs each we have enough mosquitoes quickly. So, spraying might bring the mosquito prevalence down to nearly zero (he shows a curve with his fingers), but the surviving

mosquitoes are enough to make the population survive and thrive again. And even if you kill many indoor biting mosquitoes, you just change the ecological balance. Either, the outdoor biting mosquitoes increase in numbers because they have more breeding places and less competition, or the indoor biting mosquitoes learn to avoid indoors and start biting outdoors. (Daniel Boakye, Interview 2008)

Thus, killing mosquitoes is not an easy task. Well actually, killing one mosquito is easy – *swat*– the challenge comes in if you want to diminish a mosquito population. As has been elaborated in *Chapter 6*, the most stable characteristic of mosquito control might well be its changeability. It is a game of intervention and response – under the motto of 'who can bite back faster?' The following section will take some theoretical resources at hand in order to discuss the implications of ITN entomology for policies of bednets more broadly, and relates this section to the two foregoing sections on ITN economies and user practices.

7.5 Policy Escapees: postcolonial politics, qualitative bednets and mosquitoes biting back

So, what to make of those three policy stories? Firstly, we have seen that by construing bednet distribution as a technical issue, space is granted to an alliance of industry, international NGOs and regulation authorities to *build* an international market for bednets, which marginalises the local bednet sewing economy. Secondly, through *scientific and* monitoring practices, bednets are established as a quantitative object; their value is defined through scientific studies and nets are implemented under the motto *the more the merrier*. This quantification of bednets externalises issues concerning the appropriateness of technology and other qualitative aspects – such as why bednets may be useful or useless in a specific locality or housing structure – escape. Thirdly, bednets are challenged by another

force, mosquitoes. The malaria control interventions diminish prospects of species survival and become a threat for mosquitoes. Through developing bodily tolerance to insecticides and bednet-evading blood-seeking behaviour mosquitoes react to ITNs, and in the long run threaten the success of the intervention. This is, of course, no reason to stop using bednets, but rather points to an underlying dynamic in disease control: Whatever humans will do to evade mosquitoes and other creatures harmful to human health, there will be a reaction. And importantly, as we have seen in *Section 7.4*, this reaction will always include surprise. No matter how much research efforts are strengthened, at best scientists might speculate about what could happen, but they cannot know. The agency at work here is decidedly non-human.

But why write about such diverse phenomena like politics of markets, the gap between ownership and usage, as well as entomological phenomena together in one chapter? Is there something that brings these disparate tales together? I argue that all three sections describe policy escapees. The explored issues cannot be tamed by policies, they escape the grip of public health policy on insecticide-treated bednets. Thus, if we understand bednet implementation practices performatively, we can model out which realities get created through dominant practices, and which are left out of the picture. One can argue that all policies inevitably create hinterlands. However, while some realities inevitably escape, some could be imagined otherwise, or might have been conveniently missed out. In this chapter three such left out, or marginalized realities have been explored.

But those realities not only escape the grip of malaria policies on ITNs, as we have seen they also interfere with those policies. Firstly, seeing ITNs not as an item of economic value, but rather as a public health tool, masks the politics of the market that are going on with and around ITNs. We have seen that international companies coming from Europe and Japan

are the major producers of bednets, while African enterprises have almost no involvement in ITN manufacturing. Furthermore, the large-scale factory production of bednets puts long-established, decentralised, local and small-scale bednet-sewing and -selling economies out of work. This not only reinforces unjust neoliberal global structures, but is also a missed opportunity. Considering that most people on this vast 1 billion-inhabitant continent would ideally own a bednet, bednet production could have been connected to one of the many economic development initiatives supported and initiated by Western donors. Instead bednet donations end up benefitting companies from developed countries, conveying only one of potentially many benefits to the African end-user – protection from mosquito bites.

However, as we have seen in the second section of this chapter, not even this is easy to achieve. Usage of bednets is another escapee of the current policies. Although one would assume that usage is a central concern of a malaria ITN policy, we have seen that issues, which go beyond the distribution and the monitoring of ITNs per household, are not easily graspable for within donor public health policies. As a result bednets become a quantitative object with the lived experience of bednets escaping. This, however, interferes directly with ITNs: if people do not value and use bednets in their daily lives, distributing and counting nets becomes meaningless.

The third escapee also interferes with policies, albeit this interference is so far mostly an anticipated interference. Genetic adaptation of mosquitoes to insecticides used in ITNs has been detected, and equally have first changes in biting cycles been observed. The vitality of mosquitoes threatens the effectiveness of bednets. So far this interference can only be registered by science; entomological studies keep track of resistance developments and their operational effects on ITNs. Nevertheless, mosquitoes interfere with the future of malaria control strategies and this interference is likely to become more important the more

nets spread in sub-Saharan Africa. Thus, interference is here not a merely theoretical notion, but enables us to explore and specify the relation between marginalised and the dominant realities of bednet policies.

Furthermore, those escaped realities not only interfere, but can also be used to diffract malaria policies. The act of fleshing out these three marginalized realities of bednet politics can be read as an interference in itself, because it brings those realities back into discussion, into visibility. And this brings opportunities with it. I would like to suggest that if we weave such escaped realities firmly back into the mesh of bednets, they become to be understood as a public good in more than one sense: they become not only be seen as an invaluable tool of protection against malaria, but could also become a tool to subtly redress economic politics in sub-Saharan Africa. Or to put it differently, this chapter has focused on the political economy, social and ecological life of ITNs, in order to not only better understand what makes bednets valuable and for whom, but also to open up a space for re-imagining bednets.

The following *Conclusions* will draw the conceptual threads that this doctoral thesis has developed together, elaborate on the overall argument, and think through the implications of this analysis for malaria control.

Blank Page

Chapter 8:

On the politics of co-existence

The last chapter of this thesis will attempt to draw the themes together that the empirical chapters engaged with, and think through the implications of the analysis for conceptualising and practising malaria and its control. In the chapters a particular way of reading malaria has been developed, evoked and performed. *Chapters 5-7* in particular have all discussed aspects of malaria control across social, ecological and political concerns. Human and nonhuman, democratic and ecological concerns have been juxtaposed and rubbed up against each other. By including seemingly very different concerns in the analysis I hope another way of understanding and writing malaria has emerged. In order to outline the connections, arguments and propositions the empirical chapters have made, I will in the following section draw together and reflect on the main threads of the argument. The discussion is organised in two sections *8.1 Inventive spatial topologies* and *8.2 Co-existence: enmeshed ecologies and postcolonial politics*.

8.1 Inventive spatial topologies

As we have seen in *Chapter 3,* the history of malaria control and policy narratives of current interventions seem to be caught between dreams of eradication and the arduous day-to-day realities of holding lively mosquitoes and parasites at bay. *Chapter 3* has argued that malaria control requires locally specific and ecologically subtle approaches. I proposed that specific case histories of malaria control destabilise dreams of eradication, and stress how success or failure of malaria control depends on a complex interplay between societal, bodily and ecological processes. These historical lessons, however, contrast with current policy initiatives as *Chapter 4* showed. Financial configurations of malaria control shifted considerably over the last decades, funding has increased fourfold and moved towards a

philanthropic approach in malaria control. This changed policy priorities, initiated by the Gates Foundation efforts centre on global malaria eradication for a second time in history. However, as I showed in the chapter, not only has this approach failed in the past but its revival also has problems. Furthermore, the chapter has provided an overview over the main malaria control tools connected to an eradication agenda. In this sense *Chapter 4* set the scene for a more specific analysis of malaria control interventions in Ghana that can be found in *Chapters 5-7*.

Firstly, thus, this thesis developed a thread concerned with **interventions**. *Chapter 3 -7* each discussed different aspects of malaria control interventions, and investigated (a) which logics are employed in the interventions, (b) what kind of realities emerge or are performed by those interventions, and (c) which practices are neglected in these realities. We have seen that malaria control is frequently framed as a public health intervention, and *Chapter 5 and 7* in particular explore the effects of such a framing. Albeit in slightly different modes, I argued in both chapters that the current focus on logistical, scientific and quantitative aspects, as well as a *modus operandi* of top-down implementation marginalises other aspects of interventions. We have seen that certain social, political and ecological realities of malaria control interventions *escape* (as it has been conceptualised in *Chapter 7)*. As *Chapter 5* argued, framing malaria control as a stable public health intervention does not account for today's complex configurations in malaria control. Similarly, *Chapter 7* showed that framing bednets within a public health implementation logic lets specificity and locality drift away. As a result quantitative and logistical aspects take on major importance in implementing and evaluating bednets – quantitative nets become the only imaginable/possible reality. Nevertheless, I argued that, while things inevitably escape from policies, reading policies and malaria control interventions as performative can bring escaped realities back. It sensitises us to the hinterlands or not easily accessible aspects of

an intervention, and can render marginalised realities and their importance visible again. This does not necessarily engender change or bring those realities to life, but it opens up our understanding of the intervention and helps hidden politics become visible. Through this it renders different interventions imaginable and possible; it brings them (back) into the realm of imagination and negotiation.

Furthermore, a performative reading of malaria control also suggests a different understanding of malaria itself, and of the actors and agencies involved in constituting the disease. Focusing on marginalised aspects of malaria control makes clear that there are many realities connected to the disease that became to be known as malaria. It underlines the fact that malaria has a social and political life, and that its control is not only a matter of biomedical care at the clinic, but is related to political and economic realities. Writing such aspects back into framings of malaria enables an understanding of malaria in which practices become crucial. As we have seen in *Chapter 7* the economic circuits through which mosquito nets are produced and sold matter to successful malaria control, and so too do a variety of practices related to the emergence, (self) diagnosis and prevention of malaria. The second conceptual thread of the thesis is, thus, concerned with **practices**. *Chapter 6* in particular has explored how we can locate, define and understand malaria through practices. In the chapter I have hoped to show that an array of practices are not only connected to malaria, but serve to constitute, define and locate the disease. Malaria is made up of practices: contingent and seemingly unconnected practices help us to understand the disease in a particular way, and let different malaria realities emerge. Those realities might connect well, or not so well, they might clash, or interfere with each other.

I argued that this matters to definitions of malaria. For instance, we have seen how self-diagnosis and self-treatment of malaria differs from visualising malaria parasites in the lab.

These practices result in diverging disease definitions: in one case, malaria makes itself felt in the belly, while the identification of malaria in the lab requires sharp eyes and sliced blood cells under a microscope. Nevertheless, in both cases the practice defines how we come to understand malaria, and which disease treatment options and behaviour are considered. Similarly, drug-resistant parasites not only diminish treatment options but also offer a new definition of the disease: until artemisinin-resistant parasites occurred malaria was treatable within 12 hours with artemisinin, but now cure rates have slowed down considerably changing treatment prospects and options, but also the disease itself. Thus, practising malaria is defining malaria, and vice versa.

Moreover, as the example above shows, not only human practices matter, but also, importantly, the behaviour of parasite or mosquito. If mosquito or parasite change their ways of navigating the world make they make a difference to how we understand, prevent and treat malaria. Mainly by focusing on entomological knowledge, I have attempted to shed light on the mosquito and parasite's **agency** in malaria control. And it is through paying attention to the practices of mosquito and parasite, and by relating them to human practices that the crucial challenges of malaria control become graspable. I have sought to show that social science can only understand malaria and its control when it learns to write mosquitoes and parasites into its accounts.

Furthermore, even though malaria practices emerge locally, they are not local as such either. As the history of drug resistance shows, resistant parasites develop in one locality but are avid travellers. And they use various means of transport in their travels: they are not only passed on from human to human via mosquitoes, but also travel in cars, ships or planes by using the bodies of humans or mosquitoes as vehicles. To summarise, understanding malaria as constituted by practices means a different starting point for conceptualising

malaria. If we pay attention to practices malaria becomes multiple and sometimes fragmented, but it also makes co-existence visible. It renders malaria local, while, at the same time, makes multiplicity and interdependence visible.

This is a multiplicity and interdependence across species as well as geography. And this leads me to the most explicitly spatial question that this thesis has been concerned with: How could we imagine malaria control beyond a top-down, topographical and linear **intervention imaginary**? *Chapters 3-7* showed how those imaginaries failed in different registers. Resistance challenges policy narratives of human control over malaria, and its development and spread alerts us that neither a solely local nor an overarching global strategy will do. As has become clear in all empirical chapters, malaria control is currently tied to public health narratives, as well as to a top-down implementation of pre-conceived interventions. Money, funding priorities and global policy interventions too flow from development donors to local interventions, and global policy is usually construed on the international level, and then adjusted in national policies. While this makes sense with regards to comprehensive and comparable health care, I argued that it often leads to a neglect of local concerns and specificity. Thus, there is a need for malaria control policies to account for movement between local and global, field and lab, international development donors and local users. Malaria and its control need inventive spatial imaginaries and not a "problematic geographical imagination" (Massey, 2002) that is based on neat distinctions between global/local, concrete/abstract, human/nonhuman. I suggested it firstly matters *how* we build our abstractions, but secondly aimed to show that it also matters *from where* we build abstractions. We need a global policy imaginary that thinks of malaria as emerging from practices and as inherently local (in its connections to -inter alia- politics, economy, livelihoods and vector habitats), but at the same time does not leave global dynamics (such as resistance development, global markets etc) out of the picture. This sounds very

demanding and could be confused with a call for an all-encompassing malaria policy. On the contrary, as I have attempted to show, a spatially inventive malaria policy would mean a more humble strategy that is based on specific vector-pathogen-human configurations and makes small claims. As we have seen in *Chapter 5* for instance curiosity, commitment to a locality, patience and an adaptable strategy are needed to tame mosquitoes (in this case with insecticides). *Chapter 6* has showed that if we locate malaria in practices the disease becomes less stable; its diagnosis for instance depends on the eye of the microscopist and involves a degree of luck. Conceptualising malaria like this, however, also brings possibilities with it. If we pay attention to practices and the contingencies of malaria diagnosis and treatment, we also create more space for the people suffering from and living with the disease. If we acknowledge that most people habitually co-habit with the parasites and disease, and prefer to treat themselves, we can adjust our strategies accordingly[93]. *Chapter 7* has shown that implementing bednets could benefit from a strategy that takes the local economy, net-usage culture as well as mosquito habitats and agricultural practices into account more thoroughly. If we don't want to get caught up in a vicious circle that leaves local people economically worse off, lets bednets lie unused under beds and/or harbours resistance, we would be well advised to take one step back, and take those factors into account when conceiving a bednet policy. Thus, we have in the previous chapters assembled some hints and starting points of how we could not only imagine, but also practise malaria differently. The following and last section of this thesis re-evokes, summarises and discusses a second set of concepts needed for understanding malaria differently.

---

[93] Home management of malaria projects are an example of this (Gyapong and Garshong, 2007). Similarly, this points to the need to think more thoroughly about malaria in adults and malaria in children. While malaria in adults is for most people in endemic countries a routine illness, it becomes an emergency for non-immune children very quickly. While it makes sense to treat adults at home, children's malaria needs to be supervised more closely by health care professionals in the clinic. Paying attention to practices of malaria treatment would thus allow us to adapt education and treatment strategies accordingly.

8.2 Co-existence: enmeshed ecologies and postcolonial politics

In this thesis human and non-human practices have been portrayed as profoundly intermingled and as together constituting malaria. This has presented the disease as a phenomenon of co-existence. Reading malaria in this way firstly documents how we, as humans, **co-exist with micro-organisms**; and secondly, seeing malaria as a product of our interdependence with other-than-human organisms problematises the **conditions and configurations** of this very co-existence. While malaria's ancient interconnection with humans, parasites and mosquitoes shows that the disease is an elementary part of human existence, the high death toll and disease burden make clear that this co-existence is undesirable for humans. *Chapter 3 and 4* documented how humans have in the past and are currently attempting to combat this undesired co-existence. *Chapter 3* suggested that successful malaria control takes our complex interwovenness seriously and starts with strategies that are based on a specific understanding of local disease ecologies. Subsequently, *Chapter 5* argued that resistance emphasises that this interwovenness has to be taken as a starting point: insecticide resistance necessitates careful observations of mosquito and parasite habitats and adaptations, and consequently malaria control interventions have to be fluid and adaptable too. However, as I argued in the chapter, this also requires us to rethink the logic of malaria control interventions. The status of the intervention becomes more explicitly experimental – nothing is stable or predictable in the age of insecticide resistance. And this also changes the status of public engagement. It is not about conveying the usefulness of an intervention to the public, but rather enrols publics into the real-world experiment, as it has been conceptualised in *Chapter 5*. When mosquito, parasite and malaria control staff are seen as experimenting with each other, publics too become participant rather than recipient. The chapter showed that a public health intervention logic and behaviour change communication strategies do not suit its object. I argued it is more fruitful to conceptualise the intervention as a **real-world experiment**. This

means that democratic decision making about an intervention has to actively acknowledge the experimental character of the intervention, and admit that results are unknown/unpredictable. This implies two things, firstly that 'democracy' in malaria control is a more-than-human endeavour, and secondly that malaria interventions are always, necessarily experiments. Rather than warning against such experimentality, I argue that an opportunity lies in acknowledging the experimental character. It can be seen as an opportunity to relate differently not only to the publics of public health, but also to other-than-human targets of interventions. In real-world experiments scientists, mosquitoes and the public are *all* participating in the experiment. Thus, all should have a say in how ecologies are changed and adapted. We need to learn to experiment *with*, not *on*. In this sense I suggested in *Chapter 5* that the intervention could benefit from treating mosquitoes and humans more symmetrically. If we perceive humans and mosquitoes as active makers of local ecologies and grant them the power to speak to the intervention, the result might be better and more sustainable malaria control interventions. If we allow our strategies to be questioned by mosquito's behaviour on a fundamental level, the result might be a more humble control intervention.

As we have seen in *Chapter 5*, in the age of insecticide resistance mosquitoes are already destabilising the intervention: they transform it into a game of attack and response. The crucial question in this game becomes "who bites back first?". However, paying attention to insecticide resistance and the complex ecological habitat of the *Anopheles* species complex suggests a more profound lesson: maybe the all-out war against mosquitoes in which insecticide spraying engages is futile? Taking lively and adaptive mosquitoes seriously would mean concentrating on narrowing the biological niche for the dominant malaria vectors in a locality, and restricting their biting opportunities. Similarly, taking the local residents seriously as participants in the experiment means a re-conceptualisation of the

intervention. Instead of understanding the residents as passive beneficiaries that receive an intervention, they could be seen as a source of insights and inspiration. Their knowledge and voices could be incorporated in the design from the beginning, transforming them from passive beneficiaries into active shapers of the experiment.

But the implications of this analysis transcend this specific case. Understanding malaria interventions as real-world experiments with human and nonhuman participants that all make up and shape the experiment implies a more profound rethinking of malaria control interventions. Malaria is not static; it is an evolving vector between human habits, mosquito habitats and the parasite's genome. To understand the disease and to control it, therefore, requires the kind of investigative latitude that enables evidence to be yoked to the available resources on the ground. And it requires acknowledging the active agency of all actors involved – malaria control team, mosquito and public. Agency here is not restricted to disease control staff, but distributed between humans and nonhumans. Agency is human and nonhuman, it is articulated in **enmeshed ecologies**. Successful malaria control is a shifting, moving and adaptive real-world experiment, modifying human-mosquito-parasite encounters calls for the development of a locally sensitive and specific understanding of local ecologies – of habits and habitats.

In this sense this thesis proposes that enmeshed ecologies of malaria should be our starting point for understanding, defining malaria as a disease, as well as the starting point for a disease control intervention. I have evoked those ecologies as including habits and habitats – including social, ecological and political processes. They thus include human-nonhuman encounters, but also intra-human dynamics. And this brings us to **postcolonial concerns**. Malaria is today a disease mainly of the developing world, with the major disease burden in sub-Saharan Africa. As we saw in the *Introduction and Chapter 3* its biomedical disease

history is intimately linked to imperialism, whereas today's disease interventions are mainly funded and conceptualised by development donors. The geographies of who suffers from, and who decides about how to prevent and treat malaria remain unevenly distributed. As we have seen in *Chapter 7* the politics of bednets are linked to development politics and international market dynamics. Rendering bednets into a public health tool benefits international companies that currently produce, deliver and implement insecticide-treated nets, but marginalises local small-scale economies of home-sewn bednets. I argued in *Chapter 7* that writing the political, social and ecological life back into the mesh of bednets does two things. Firstly, focusing on "escaped" realities of bednets shows that malaria control and its tools are inherently political. The decision to prioritise insecticide-treated nets and to organise supply chains through development donors has configured the market of nets in a particular way. Secondly, bringing the marginalised or escaped realities of nets back to this current configuration creates space for other realities of nets to become visible, to be considered and (potentially) valued. For instance, we have seen in *Chapter 7* that qualitative aspects of why people use or don't use nets matter, but cannot be accounted for in current net policies. The chapter argued that if we weave such 'side aspects' into the mesh of bednets, they can be understood as a public good in more than one sense: They are an invaluable tool to protect against malaria, but can also become a tool to subtly redress economic politics in sub-Saharan Africa.

In this sense it seems imperative to not assume an equal playing field, but instead to write geographical difference into the ecologies of malaria. The thesis attempted to make a start at thinking malaria beyond an equal playing field, and to give malaria control social, political and ecological texture. Understanding and conceptualising malaria as a disease emerging from enmeshed ecologies and characterised by postcolonial dilemmas also enables us to see that the question "who bites back first?" is flawed. This question is in the title of this

thesis and it evokes my analysis of the current state of malaria control, which to me is caught in a game of attack and response. And in this sense malaria control is at a crossroads: while in 2008 a renewed eradication policy was endorsed, in the very same year cases of artemisinin-resistant malaria were confirmed in Cambodia. Emerging resistance destabilises dreams of eradication and defines eradication attempts as an arms race: while philanthropists and policy makers aim to 'shrink the malaria map from the margins to the heartlands', the parasite biologically adapts to malaria drugs, and thus creates its own version of a new malaria map. This thesis has suggested that we need to let go of this logic of an arms race, if we want to control malaria sustainably as well as in a way that benefits the millions of patients, who deal with malaria in their everyday lives. We need to learn to take patients like Kwaku as well as mosquito and parasite seriously if we want to control malaria successfully and sustainably. I have argued that this requires understanding malaria and its control differently, as a phenomenon of co-existence and enmeshed ecologies that encompass social, political and ecological realities. I would like to close with a quote from a historian of malaria, who made similar argument several decades ago, after the first malaria eradication campaign ended. He summarises the task aptly:

> Failure of the idea of mosquito eradication has in truth left a vacuum (...) It may be that the most damaging legacy of eradication developed military minds: The game, they thought, must go to them or to us, win or be defeated. But there were sceptics of the eradication strategy all along who protested that this was not the real choice in a world where man habitually copes with recurrent and perennial problems that he can never hope to resolve and put away forever. Protecting ourselves against a malarial plasmodium can be accepted as quite probably a task for all time without being daunted by the prospect. (Harrison, 1978: 260)

Blank Page

References

Afenyadu, G.Y. et al. (2005). Improving access to early treatment of malaria: a trial with primary school teachers as care providers. *Tropical Medicine and International Health*, Vol. 10(10):1065–1072

Affordable Medicines Facility for malaria AMFm (2009). *Introduction to the AMFm*. Available via: http://www.mmv.org/article.php3?id_article=602 (04/05/09)

Agyepong, I.A. and Adjei,S. (2008).Public social policy development and implementation: a case study of the Ghana National Health Insurance scheme. *Health policy and planning*, Vol. 23(2): 150-160

Agyepong I.A. et al. (2002). Strategies to improve adherence to recommended chloroquine treatment regimes: a quasi-experiment in the context of integrated primary health care delivery in Ghana. *Social Science and Medicine*, Vol. 55:2215–2226

Agyepong, I. and Manderson, L. (1999). Mosquito Avoidance and Bednet Use in the Greater Accra Region, Ghana. *J. biosoc. Sci.,* Vol.31: 79–92

Aikins, M.K., H. Pickering and B.M. Greenwood (1994). Attitudes to Malaria, Traditional Practices and Bednets (Mosquito Nets) as Vector Control Measures: A Comparative Study in Five West African Countries. *Journal of Tropical Medicine and Hygiene*. Vol., 97, pp.81-86

Akogbéto M, Yakoubou S (1999). Resistance des vecteurs du paludisme vis a vis des pyrethrinoides utilises pour l'impregnation des moustiquaires au Benin, Afrique de l'Ouest. *Bull Soc Path Exot*, Vol.92:123-130

Akrich, M (1992). The De-Scription of Technical Objects. In Bijker, W. and Law, J. (eds). *Shaping Technology/Building Society.* Cambridge: MIT Press. pp: 205–24

Akrich, M. (1994). Essay of Techno-Sociology: A Gasogene in Costa Rica. In Lemonnier, P. (ed.). *Technological Choices*. London and New York: Routledge. pp: 289–337

Alonso P.L., Lindsay S.W., Armstrong J.R.M., et al. (1991). The effect of insecticide treated bednets on mortality of Gambian children. *Lancet,* Vol. 337: 1499–1502

Alonso PL, Sacarlal J, Aponte JJ, et al. (2004). Efficacy of the RTS,S/AS02A vaccine against Plasmodium falciparum infection and disease in young African children: randomized controlled trial. *Lancet*, 1622; 364(9443):141120

Alonso PL, Sacarlal J, Aponte JJ, et al. (2005). Duration of protection with RTS,S/AS02A malaria vaccine in prevention of Plasmodium falciparum disease in Mozambican children: singleblind extended followup of a randomised controlled trial. *Lancet*, 10;366(9502):20128

Anderson, W. (2002). Postcolonial technoscience. *Social Studies of Science*. Vol. 32: 643-58.

AngloGoldAshanti (2007). *Annual Report 07. Report to Society.* Available via: http://www.anglogoldashanti.com/subwebs/InformationForInvestors/Reports07/ReportToSociety07/default.htm (22/09/08)

Ansah E.K. et al. (2001). Improving adherence to malaria treatment for children: the use of pre-packed chloroquine tablets vs. chloroquine syrup. *Tropical Medicine and International Health*, Vol. 6(7):496–504

Aponte JJ, Aide P, Renom M, et al. (2007). Safety of the RTS,S/AS02D candidate malaria vaccine in infants living in a highly endemic area of Mozambique: a double blind randomised controlled phase I/IIb trial. *Lancet*, Vol.3;370(9598):154351

Arguin PM, Marano N, Freedman DO (2009). Globally mobile populations and the spread of emerging pathogens. *Emerging Infectious Diseases*. Vol. 15, No.11: 1713-14

Armstrong, P. (2002). The Postcolonial Animal. *Society and Animals* 10(4): 413-19

Arnold, D. (2000). *Science, Technology and Medicine in Colonial India. The New Cambridge History of India*. Cambridge: University Press

Arrow, K. J., Panosian, C., Gelband, H. et al. (2004). *Saving Lives, Buying Time. Economy of Malaria Drugs in an Age of Resistance*. Washington: National Academies Press

Asad, T. (1973). *Anthropology and the Colonial Encounter*. London: Ithaka Press

Asenso-Okyere, W.K. and Dzator, J.A. (1997). Household cost of seeking malaria care. A retrospective study of two districts in Ghana. *Social Science and Medicine*, Vol. 45(5), pp.659-667

Asidi, A.N., et al. (2004). Experimental hut comparisons of nets treated with carbamate or pyrethroid insecticides, washed or unwashed, against pyrethroid-resistant mosquitoes. *Med. Vet. Entomol.* Vol. 18:134—140

Asidi, A.N., et al. (2005). Experimental hut evaluation of bednets treated with an organophosphate (chlorpyrifos-methyl) or a pyrethroid (lambdacyhalothrin) alone and in combination against insecticide-resistant *Anopheles gambiae* and *Culex quinquefasciatus* mosquitoes. *Malaria Journal*. Vol. 4: 25

Attaran, A., Barnes, K.I., Curtis,C. (2004). WHO, the Global Fund, and medical malpractice in malaria treatment. *Lancet,* Vol.363: 237–40

Bate, R. et al. (2008) Antimalarial Drug Quality in the Most Severely Malarious Parts of Africa – A Six Country Study. *PLoS ONE* 3;5: e2132

Batemann, R. (2008). *Pesticide Use in Cocoa. A Guide for Training, Administrative and Research Staff*. Accessible via: *www.cocoafederation.com/issues/Manual_ICCO_1stEd_c.pdf* (02/03/2010)

Bejon,P., Lusingu, J., Olotu, A. et al. (2008). Efficacy of RTS,S/AS01E Vaccine against Malaria in Children 5 to 17 Months of Age. *New England Journal of Medicine* 359;24: 2521-32

Bingham, N. (2006). Bees, butterflies, and bacteria: biotechnology and the politics of nonhuman friendship. *Environment and Planning A*. Vol. 38: 483-498

Binka, F.N., Adongo, P. (1997). Acceptability and use of insecticide impregnated bed-nets in northern Ghana. *Tropical Medicine and International Health*, Vol.2:499–507

Binka, F.N., Kubaje, A., Adjuik, M. et al. (1996). Impact of permethrin impregnated bednets on child mortality in Kassena-Nankana district, Ghana: a randomized controlled trial. *Trop Med Int Health*, Vol. 1: 147–154

Blaut, J.M. (1993). *The Colonizer's Model of the World. Geographical Diffusionism and Eurocentric History*. New York: Guilford

Bonneuil, C. (2000). Development as Experiment: Science and State Building in Late Colonial and Postcolonial Africa, 1930-1970. *Osiris*. Vol. 15, pp. 258-281

Bonneuil, C., Joly, P-B. and Marris, C. (2008). Disentrenching Experiment: The Construction of GM Crop Field Trials as a Social Problem. *Science Technology Human Values*. 33,2: 201-229

Braun, B. (2005). "Book review symposium: Hugh Raffles: *In Amazonia: A Natural History*." *Antipode* 37, 2: 348-378

Breslauer, D.N. et al. (2009). Mobile phone based clinical microscopy for global health applications. *PloS One* 4, No. 7: e6320

Brieger, B. (28/2/09). Implementing MIP interventions in Ghana. Accessible via: http://www.malariafreefuture.org/blog/ (02/03/09)

Brooke, B.D. (2008). kdr: can a single mutation produce an entire insecticide resistance phenotype? *Transactions of the Royal Society of Tropical Medicine and Hygiene*. Vol. 102: 524-525

Browne, E. et al. (2001). *Early appropriate home management of fevers in children aged 6 months to 6 years in Ghana* (unpublished report)

Bruce-Chuvatt, LJ (1981). Alphonse Laveran's discovery 100 years ago and today's global fight against malaria. *Journal of the Royal Society of Medicine* 74, No. 7: 531-536

Bugembe, A. (17/07/2009). Uganda: DDT Indoor Spraying Resumes Next Year. Kampala: *The New Vision*

Bulterys, P.L., Mharakurwa, S. and Thuma, P.E. (2009). Cattle,other domestic animal ownership, and distance between dwelling structures are associated with reduced risk of recurrent Plasmodium falciparum infection in southern Zambia. *Tropical Medicine and International Health*. Vol. 14 no 5: 522–528

Callon, M. (2007). What Does It Mean to Say That Economics Is Performative?, in D. MacKenzie et al. (eds). *Do Economists Make Markets? On the Performativity of Economics*. Princeton: Princeton University Press pp. 311–57

Campbell C.C. et al. (1979) Chloroquine resistance in Plasmodium falciparum from East Africa. *Lancet,* Vol. 2: 1151-1154

Carlson, D. (1984). *Africa Fever: A Study of British Science, Technology and Politics in West Africa, 1784-1864*. Canton: History Publications USA

Carson R. (1962). *Silent Spring*. Boston: Houghton Mifflin

Carter, E. (2007). Development narratives and the uses of ecology: malaria control in Northwest Argentina, 1890-1940. *Journal of Historical Geography*, Vol. 33: 619-650

Carter, E. (2008a). State visions, landscape, and disease: Discovering malaria in Argentina, 1890–1920. *Geoforum* 39: 278–293

Carter, E. (2008b). "God Bless General Perón": DDT and the Endgame of Malaria *Eradication in Argentina in the 1940s. Journal of the History of Medicine and Allied Sciences* 64 (1): 78-112

Chakrabarty, D. (2000) *Provincializing Europe: Postcolonial Thought and Historical Difference.* Princeton: Princeton University Press

Clark, N. L. (1994). Agriculture. In: La Verle, B (ed). *A Country Study: Ghana*. Library of Congress Federal Research Division. Accessible via: http://lcweb2.loc.gov/frd/cs/ghtoc.html (21/02/2010)

Clifford, J., Marcus, G. (1986). *Writing culture. The poetics and politics of Ethnography.* Berkeley: University of California Press

Coetzee, M. (2006). Insecticide resistance in malaria vector mosquitoes in a gold mining town in Ghana and implications for malaria control. *Bull Soc Pathol Exot.* Vol. 99, 5: 400-403

Coll-Seck, A. (02/03/2010). *Prof Awa Marie Coll-Seck, from the Roll Back Malaria partnership, live online. The Guardian Katine Chronicles Blog.* Accessible via: http://www.guardian.co.uk/katine/katine-chronicles-blog/2010/mar/02/awa-marie-coll-seck-malaria *(02/03/2010)*

Coll-Seck, A. (2007). *A Global Subsidy for ACTs: a RBM Perspective*. Available via: http://www.appmg-malaria.org.uk/presentations/?RESETTIMERS=1andINTSTARTROW=32 (30/05/07)

Cooke, B. and Kothari,U. (2001). *Participation:The new tyranny?* London: Zed Books

Curtis C.F., Lines J.D., Carnevale P. et al. (1991). Impregnated bed nets and curtains against malaria mosquitoes. Curtis CF, ed. *Appropriate Technology For Vector Control.* Boca Raton, FL: CRC Press, 5-45

D'Alessandro U., Olaleye B.O., McGuire W. et al. (1995). Mortality and morbidity from malaria in Gambian children after introduction of an impregnated bednet programme. *Lancet 345:* 479–483

Darriet, F. et al. (2000). Impact of pyrethrin resistance on the efficacy of impregnated mosquito nets in the prevention of malaria: results of tests in experimental cases with deltamethrin. *SC. Bull. Soc. Pathol. Exot*. 93, 131—134

Derrida J. (2002). The animal that therefore I am (more to follow). *Critical Inquiry* 28, 369: 418

Desowitz, R.S. (1991). *The Malaria Capers. Tales of Parasites and People*. New York: W.W. Norton and Company

Dondorp, A.M. et al. (2004) Fake antimalarials in Southeast Asia are a major impediment to malaria control: multinational cross-sectional survey on the prevalence of fake antimalarials. *Tropical Medicine and International Health* 9; 12: 1241–1246

Dondorp, A.M. et al. (2009) Artemisinin Resistance in Plasmodium falciparum Malaria. *The New England Journal of Medicine* 361;5: 455-67

Economist (18/09/2008). *Counting Bites: The number of malaria cases is down sharply, for reasons good and bad*. The Economist

Enayati, A. and Hemingway, J. (2010). Malaria Management: Past, Present, and Future. *Annu. Rev. Entomol.* Vol. 55:569–91

Environmental Protection Agency Ghana (EPA Ghana) (2006). USE OF Dichloro-Diphenyl-Trichloroethane (DDT) in Ghana for Malaria Control. Available via: www.freeonlineresearchpapers.com (13/09/08)

Fanon, F. (1967). *Black Skin, White Masks*. New York: Grove

Farid, M.A. (1998). The malaria campaign – why not eradication? Interview with M.A. Farid. *World Health Forum*, No.10: 417-27

Feachem,R.G.A., Phillips, A.A. and Targett, G.A. (2009). *Shrinking the Malaria Map. A Prospectus on Malaria Elimination*. San Francisco: The Global Health Group

Ferguson, J. (1994) *The Anti-Politics Machine: 'Development', depoliticisation and bureaucratic power in Lesotho*. Minneapolis: University of Minnesota Press

Flick, U. (2000). *Qualitative Forschung. Theorie, Methoden, Anwendung in Psychologie und Sozialwissenschaften*. Hamburg: Rowohlt

Fuller, T. (27/01/2009). Spread of Malaria Feared as Drug Loses Potency. New York Times. http://www.nytimes.com/2009/01/27/health/27malaria.html?_r=1 (28/02/09)

Gallup, J.and Sachs, J. (2001).The Economic Burden of Malaria. *American Journal of Tropical Medicine and Hygiene* 64 (1-2): 1410-12

Gates, B. (17/10/2007). *Malaria Forum Keynote Address: Bill Gates*. Available via: http://www.gatesfoundation.org/speeches-commentary/Pages/bill-gates-malaria-forum.aspx (12/05/09)

Gates, M. (17/10/2007). *Malaria Forum Keynote Address: Melinda French Gates*. Available via: http://www.gatesfoundation.org/speeches-commentary/Pages/melinda-french-gates-2007-malaria-forum.aspx

GFATM (2008). *Proposal Form Round 8 – Malaria*. Available via: http://www.theglobalfund.org/programs/grant/?compid=1678andlang=enandCountryId=GHN (13/01/09)

Ghana Country Coordinating Mechanism (Ghana CCM) (2008). *Proposal Form – Round 8*. Available via: http://www.theglobalfund.org/programs/grant/compid=1678andlang=enandCountryId=GHN (12/05/09)

Ghana Health Service GHS (19/12/2005). *Food and Drugs Board Takes Action On Artesunate Amodiaquine*. Available via: http://www.ghanahealthservice.org/articles.php?nd=33andtt=F (22/02/2009)

Global Business Coalition (2009). *Improving Global Bed Net Procurement: Stakeholder Action Proposal*. Accessible via: http://www.gbcimpact.org/itcs_node/0/0/report/2004 (01/08/09)

Gorgas, W.C. (1915). *Sanitation in Panama*. New York: Appleton

Greenwood, B.; Bojang, K., Whitty, C., Targett, G. (2005). Seminar: Malaria. *Lancet*. 365, pp. 1487-1498

Gyapong, M. and Garshong, B. (2007). *Lessons learned in Home Management of Malaria Implementation Research in four African countries*. Geneva: World Health Organization and Special Programme for Research and Training in Tropical Diseases

Gyapong, M. et al. (1996). Introducing insecticide- impregnated bednets in an area of low bednet usage: an exploratory study in north-east Ghana. *Tropical Medicine and International Health*, 1:328–333

Haraway, D.J. (1991). A Cyborg Manifesto: Science, Technology, and the Socialist-Feminism in the late twentieth Century. In: Haraway, D. *Simians, Cyborgs, and Women: The Reinvention of Nature*. London: Free Association Books, pp.: 149-181

Haraway, D.J. (1992). The Promises of Monsters. A Regenerative Politics for Inappropriate/d Others. In: Grossberg, L., Nelson, C., Treichler, P. A.. *Cultural Studies*. New York: Routledge, pp.: 295-337

Haraway, D.J. (1994). A Game of a Cat's Cradle: Science Studies, Feminist Theory, Cultural Studies. *Configurations*, 2.1, pp.: 59-71

Haraway, D.J. (2008). *When species meet*. Minneapolis: University of Minnesota Press

Harrison, G. (1978). *Mosquitoes, Malaria and Man: A History of the Hostilities since 1880*. London: John Murray

Harte, J., Holdren, C., Schneider, R., Shirley, C. (1991). *Toxics A to Z. A guide to everyday pollution hazards*. London: University of California Press

Haynes, Douglas Melvin (2001). *Imperial medicine : Patrick Manson and the conquest of tropical disease*. Pennsylvania: University Press

Health News (05/04/2005). *Chloroquine not first choice drug for malaria*. Retrieved from www.ghanaweb.com (02/01/09)

Herrera, S. (2005). Synthetic biology offers alternative pathways to natural products. *Nature Biotechnology.* Vol. 23, pp. 270 – 271

Hinchliffe, S., Bingham, N. (2007). Mapping the multiplicities of Biosecurity. In: Ali, H., Keil, R.. *Networked Disease*. Oxford: Blackwell

Hinchliffe, S., Kearnes, M. B., Degen, M., Whatmore, S. (2005). Urban wild things: a cosmopolitical experiment. *Environment and Planning D: Society and Space*. Vol. 23, pp. 643-658

Hinchliffe, S., Whatmore, S. (2006). Living Cities: Towards a Politics of Conviviality. *Science as Culture*. Vol. 15, No. 2, pp. 123–138

Hird, M. (2009). *The Origins of Sociable Life: Evolution After Science Studies*. Hampshire: Palgrave Macmillan

Holtz and Kachur, (2004). The Reglobalization of Malaria. In: Fort, M., Mercer, M.A., Gish, O. (2004). *sickness and WEALTH. The Corporate Assault on Global Health*. Cambridge: South End Press

Humphreys, M. (2001). *Malaria: Poverty, race and public health in the United States*. Baltimore: JHU Press

Irwin, A. and Wynne, B. (1996). *Misunderstanding Science? The Public Reconstruction of Science and Technology*. Cambridge: University Press

Jazeel, T. and McFarlane, C. (2010). The limits of responsibility: a postcolonial politics of academic knowledge production. *Transactions of the Institute of British Geographers* 35(1): 109-124

Kapuscinski, R. (2001). *The Shadow of the Sun*. London: Penguin Books

Killeen, G.F. (2003). Following in Soper's footsteps: northeast Brazil 63 years after eradication of *Anopheles gambiae. Lancet Infectious Diseases; 3: 663-6*

Killeen, G.F. and Smith, T. (2007). Exploring the contributions of bed nets, cattle, insecticides and excitorepellency to malaria control: a deterministic model of mosquito host-seeking behaviour and mortality. *Transactions of the Royal Society of Tropical Medicine and Hygiene*. Vol. 101, 867-880

Killeen, G.F. et al. (2006). Quantifying behavioural interactions between humans and mosquitoes: Evaluating the protective efficacy of insecticidal nets against malaria transmission in rural Tanzania. *BMC Infectious Diseases.* Vol. 6:161

Killeen, G.F. et al. (2010). Integrated Vector Management in Africa. Wellcome Trust Strategic Award Funding Proposal. [unpublished]

Killeen, G.F., Fillinger, U., Kiche, I. et al (2002). Eradication of *Anopheles gambiae* from Brazil: lessons for malaria control in Africa? *Lancet Infectious Diseases* ; 2: 618–27

Killeen, GF et al. (2002) Eradication of Anopheles gambiae from Brazil: lessons for malaria control in Africa? *The Lancet Infectious Diseases* 2, no. 10: 618-627

Klein, H.S. (1999). *The Atlantic Slave Trade*. Cambridge University Press

Klinkenberg, E. (2008). Impact of urban agriculture on malaria vectors in Accra, Ghana. *Malaria Journal.* Vol. 7:151

Kochi, A. (2006). *WHO Malaria Head to Environmentalists: "Help save African babies as you are helping to save the environment."* Available via: http://www.who.int/topics/malaria/en/ (02/11/06)

Kohler, R. (2002). *Landscapes and labscapes*. Chicago: University Press

Konadu-Aygemang, K. (2000). The Best of Times and the Worst of Times: Structural Adjustment Programs and Uneven Development in Africa: The Case of Ghana. *Professional Geographer,* Vol. 52(3): 469-83

Koram, K.A. and Molyneux, M.E. (2007). When is "malaria" malaria? The different burdens of malaria infection, malaria disease, and malaria-like illnesses. *The American Journal of Tropical Medicine and Hygiene* 77, no. 6 Suppl: 1-5.

Koram. K., Quaye, L., Abuaku, B. (2008). Efficacy of Amodiaquine/Artesunate Combination Therapy for uncomplicated malaria in children under five years in Ghana. *Ghana Medical Journal* 42/2: 55-60

Kotey, P.A. (1998). *Twi-English/English-Twi dictionary.* New York: Hippocrene Books

Krohn, W., Weyer, J. (1994). Society as a Laboratory: The Social Risks of Experimental Research. *Science and Public Policy* 21.3: 173–83

Kwei, R. (19/11/07). Ghana Receives Commendation. Ghana has been commended for playing a leading role in the establishment of safety monitoring systems for medicines in Africa. *The Daily Graphic*. Available via: http://www.graphicghana.com/print_this_story.asp?smenu=1andsdetail=1264(20/11/2008)

Lancet (2005). Gates leads on malaria funding. *The Lancet*. Vol 366: 1586

Langwick, S. (2007). Devils, Parasites and Fierce Needles. Healing and the Politics of Translation in Southern Tanzania. *Science, Technology and Human Values*. Vol.32, N.1: 88-117

Latour, B. (1988). *Pasteurisation of France*. Harvard: University Press

Latour, B. (1993). *We Have Never Been Modern*. London: Harvester Wheatsheaf

Latour, B. (2005) *Reassembling the Social: an Introduction to Actor-Network-Theory*. Oxford: Oxford University Press

Law, J. (1994). *Organizing Modernity*. Oxford: Blackwell

Law, J., Mol, A. (2002). *Complexities: Social Studies of Knowledge Practices*. Durham: Duke University Press

Law, J. (2004a). *After Method. Mess in social science research*. London: Routledge

Law, J. (2004b). And if the global were small and noncoherent? Method, complexity, and the baroque. *Environment and Planning D*. Vol 22, pp: 13-26

Law, J. (2009). Seeing like a survey. *Cultural Sociology*. Vol. 3(2): 239–256

Leach, M., Scoones, I. and Wynne, B. (2005). *Science and Citizens. Globalization and the Challenge of Engagement*. London: Zed

Lederberg, J. (2003). Of Men and Microbes. Understanding SARS and Infectious Disease. *New Perspectives Quarterly*, Vol.21 (2)

Lezaun, J. and Millo, Y. (2006). Regulatory Experiments: GM Crops and Financial Derivatives on Trial. *Science and Public Policy*. Vol. 33(3): 179-190

Lines, J., Whitty,CJM, Hanson, K. (2009). *Prospects for eradication and elimination of malaria. A technical briefing for DFID*. Available via: www.lshtm.ac.uk/.../Elimination_and_eradication_for_DFID.doc (06/07/09)

Litsios, S. (1996). *The Tomorrow of Malaria*. Wellington: Pacific Press

Lorimer, J. (2007). Nonhuman charisma. *Environment and Planning D: Society and Space*, 24 (5) 911 – 932

McEwan, C. (2001). Postcolonialism, feminism and development: intersections and dilemmas. *Progress in Development studies* 1, 2: 93-111

Mackintosh, M. Mensah, K. Henry, L. Rowson, M. (2006). "Aid, restitution and fiscal redistribution in health care: implications of health professionals' migration" *Journal of International Development*., Vol. 18: 757–770

Mackinnon M.J., Read A.F. (2004) Immunity promotes virulence evolution in a malaria model. *PLoS Biol* 2(9): e230.

Malaria No More (2009). *G8 Pledges 100 Million Nets by 2010*. Accessible via: http://www.malarianomore.org.uk/static/OurApproach (27/07/09)

MalariaConsortium (Nov 2009). *NEWS RELEASE: Resistance to Malaria Drugs Spreading in SE Asia*. Available via: http://www.malariaconsortium.org/news/resistance_to_malaria_drugs_spreading_in_se_asia.htm (22/03/2010)

Malowany, M. (2000). Unfinished Agendas: Writing the History of Medicine of sub-Saharan Africa. *African Affairs*, 99: 325-49

Mandavilli, A. (2006). DDT returns. *Nature Medicine* Vol. 12, 8: 870-71

Marcus,G. (1998). *Ethnography through thick and thin*. Princeton University Press

Marsh, K. (2002). Immunology of Malaria. In: Warrell D A, Gilles H M (eds). *Essential Malariology*. London: Arnold. Pp 252-267

Massey, D. (2004) *For Space*. London: Sage

McGregor, J. (2005). Crocodile crimes: people versus wildlife and the politics of postcolonial conservation on Lake Kariba, Zimbabwe. *Geoforum* 36(3), 353-369

McNeill, W.H. (1977). *Plagues and Peoples*. New York: Doubleday

Mensah, J., Oppong,J.R. and Schmidt,C. M. (2009). Ghana's National Health Insurance Scheme in the Context of the Health MDGs–An Empirical Evaluation Using Propensity Score Matching. *Ruhr Economic Papers*

Medicines for Malaria Venture MVV (2007). *Medicines for Malaria Venture Annual Report 2007*. Available via: www.mmv.org/IMG/pdf/mmvAR07_Lrez_All.pdf (06/07/08)

Miguel, C.A., Tallo, V.L., Manderson, L. and Lansang, M.A. (1999). Local knowledge and treatment of malaria in Agusan del Sur, The Philippines. *Social Science and Medicine*. Vol.48, pp. 607-618

Minakawa, N. et al. (2008). Unforeseen misuses of bed nets in fishing villages along Lake Victoria. *Malaria Journal* 2008, 7:165

Mitchell, T. (2002). Can the mosquito speak? In: *Rule of Experts: Egypt, Techno-politics, Modernity*. Berkeley: University of California Press, pp.19-53

Mol, A. (1999) Ontological Politics. A word and some questions. In: Law, J., Hassard,J. *Actor network theory and after*. Oxford: Wiley-Blackwell, p. 74-89

Mol, A. (2002). *the body multiple: ontology in medical practice*. Durham: Duke University *Press*

Molineaux, L. and Gramiccia, G. (1980). *The Garki Project: Research on the Epidemiology and Control of Malaria in the Sudan Savanna of West Africa*. *Geneva: World* Health Organization.

Moser, I. (2007). Making Alzheimer's Disease matter: Enacting, interfering and doing politics of nature. *Geoforum*

Mosse, D. (2005). *Cultivating Development: An Ethnography of Aid Policy and Practice.* London: Pluto Press

Moyo, D. (2009). *Dead aid: why aid is not working and how there is another way for Africa.* New York: Farrer, Strauss and Giroux

MSF (2008). *Full Prescription: Better malaria treatment for more people, MSF's experience.* Brussels: Medicins Sans Frontieres

Muela Haussman, S., Ribera J.M., Tanner, M. (1998). Fake malaria and hidden parasites – the ambiguity of malaria. *Anthropology and Medicine*, 5(1):43–61

Muturi, E. et al. (2009). Spatial distribution, blood feeding pattern, and role of Anopheles funestus complex in malaria transmission in central Kenya. *Parasitol Res.* DOI 10.1007/s00436-009-1543-5

MVI (2008). *Fact sheet: RTS,S/AS malaria vaccine candidate.* Available via: www.malariavaccine.org/files/12052008__RTSSfactsheet.pdf (30/11/08)

Mwensi, H.A. (2005). Social science research in malaria prevention, management and control in the last two decades: An overview. *Acta Tropica 95*, pp.292-297

N'Guessan R., Corbel V., Akogbeto M., Rowland M. (2007). Reduced efficacy of insecticide-treated nets and indoor residual spraying for malaria control in pyrethroid resistance area, Benin. *Emerg Infect Dis. Vol.* 13: 199—206

NetMark (2000). NetMark Regional Africa Program Briefing Book. Insecticide Treated Materials in Ghana. Accessible via: www.netmarkafrica.org/Countries/ghana/ghana_briefing_book.pdf *(27/04/08)*

NetMark (undated). Strengthening African Net Manufacturing. accessed via http://www.netmarkafrica.org/Tech%20Transfer/Strengthening%20African%20manufacturing.pdf (09/10/2009)

Nevill C.G., Some E.S., Mungala V.O. et al. (1996). Insecticide-treated bednets reduce mortality and severe morbidity from malaria among children on the Kenyan coast. *Trop Med Int Health 1:* 139–146

Nieto, T., Mendez, F and Carrasquilla, G. (1999). Knowledge, beliefs and practices relevant for malaria control in an endemic urban area of the Colombian Pacific. *Social Science and Medicine.* Vol. 49, pp. 601-609

Noedl, H et al. (2008) Letter to the Editor: Evidence of Artemisinin-Resistant Malaria in Western Cambodia. *New England Journal of Medicine* 359, 24: 2619-2620

Ntoumi, F., Kwiatkowski, D.P., Diakité, M. et al. (2007). New Interventions for Malaria: Mining the Human and Parasite Genomes. *Am. J. Trop. Med. Hyg.*, 77 (Suppl 6), 2007, pp. 270–275

Odeke, A. (06/04/2005). Malaria wedding dress net decline. *BBC Focus On Africa magazine*. Accessible via: http://news.bbc.co.uk/go/pr/fr/-/1/hi/world/africa/4393375.stm (12/09/2008)

Okoye, P. et al. (2009). Characterisation of DDT, pyrethroid and carbamate resistance in *Anopheles funestus* from Obuasi, Ghana. *Transactions of the Royal Society of Tropical Medicine and Hygiene*. Vol.102, 591—598

Overgaard,H.J., Angstreich, M.G. (2007). WHO promotes DDT? *Lancet Infectious Diseases* Vol.7: 632-33

Owusu-Agyei, S. et al. (2009). Epidemiology of malaria in the forest-savanna transitional zone of Ghana. *Malaria Journal*. Vol. 8:220, pp:1-10

Oxfam (2009). *Your money or your life: Will leaders act now to save lives and make health care free in poor countries?* Accessible via: http://www.oxfam.org.uk/resources/policy/health/downloads/bp_your_money_%20or_your_life.pd (23/05/2010)

Packard, R. M. (2007). *The making of a tropical disease: A short history of Malaria*. Baltimore: JHU Press

Pates, H. and Curtis, C. (2005). Mosquito Behaviour and Vector Control. *Annu. Rev. Entomol*. Vol. 50:53–70

Pestre, D. (2003). Regimes of knowledge production in society: Towards a more political and social reading. *Minerva*, 41 (3): 245-61

Petryna, A. (2009). *When experiments travel. Clinical trials and the Global Search for Human Subjects*. New Jersey: Princeton University Press

Pinto J. et al. (2007): Multiple origins of knockdown resistance mutations in the afrotropical mosquito vector Anopheles gambiae. *PLoS ONE. Vol.* 2(11):e1243

Plowe, C.V. (2009). The evolution of drug-resistant malaria. *Transactions of the Royal Society of Tropical Medicine and Hygiene* 103S, S11—S14

Pols, J. (2003). Enforcing patient rights or improving care? The interference of two modes of doing good in mental health care. In: *Sociology of Health and Illness Vol. 25 No. 4, pp. 320–347*

Raffles, H. (2002). In *Amazonia: A Natural History*. Princeton: University Press

Read, A., Lynch, P.A., Thomas, M.P. (2009). How to Make Evolution-Proof Insecticides for Malaria Control. *PLoS Biol* 7(4): e1000058. doi:10.1371/journal.pbio.1000058

Roberts, L. and Enserink, M. (2007). Did they really say... eradication? *Science*, Vol. 318:1544-1545

Robinson, J. (2003) Postcolonialising geography: tactics and pitfalls. *Singapore Journal of Tropical Geography,* Vol. 24(3): 273-289

Roll Back Malaria Partnership RBM (2008). *The Global Malaria Action Plan: for a malaria free world*. Geneva: RBM

Rosengarten, M. and Michael, M. (2009). *Ethics and Ontology: HIV biomedical prevention*. Unpublished conference paper. Presented at CRESC 5th Annual Conference, Manchester 2009

Ross, R. (1910). *The prevention of malaria*. London: John Murray

Russel, P. (1955). *Man's Mastery of Malaria*. London: Oxford University Press

Sachs, J, Chambers, RG (2009). The New Global War on Malaria. In: Clapham, A, Robinson, M. *Realizing the Right to Health, Volume 3.* Zurich: ruffer and rub

Sadasivaiah, S., Tozan,Y. and Breman, J.G. (2007). Dichlorodiphenyltrichloroethane (DDT) for Indoor Residual Spraying in Africa: How Can It Be Used for Malaria Control? *Am. J. Trop. Med. Hyg.*, 77(Suppl 6), pp. 249–263

Santolamazza, F. et al. (2008). Distribution of *knock-down resistance* mutations in *Anopheles gambiae* molecular forms in west and west-central Africa. *Malaria Journal. Vol.* 7:74

Schumaker, L. (2002). Malaria. In: Cooter, R., and Pickstone, J. V.. *Medicine in the twentieth century*. London: Taylor and Francis

Scott, J (2009). *The Art of Not Being Governed: An Anarchist History of Upland Southeast Asia.* Yale: University Press

Scott, J. (1998). *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed.* New Haven: Yale University Press

Sereda B., Bouwman, H., Kylin, H. (2009). Comparing Water, Bovine Milk, and Indoor Residual Spraying as Possible Sources of DDT and Pyrethroid Residues in Breast Milk. *Journal of Toxicology and Environmental Health, Part A*, 72:14,897 — 908

Serres, M. (1982). The Parasite. Baltimore: John Hopkins University Press

Service M. W., Townson H. (2002). "The *Anopheles* vector". In Warrell, D.A., Gilles H.M.. *Essential Malariology*. London: Arnold. pp 59-84

SFU (2008). *Buy a bed net, save a life this Christmas.* http://www.sfu.ca/sfunews/news/story_12300834.shtml (last accessed 16/09/09)

Shiner, C. (24/04/2009). *Africa: Battling Malaria - Choosing a Corner.* All Africa.com

Singh, J. (2008). The UK Nanojury as 'upstream' public engagement. *Participatory Learning and Action*. Vol. 58: 1, pp. 27-32

Snowden, F. M. (2006). *The conquest of malaria. Italy: 1900-1962. Yale*: University Press.

Spinuzzi, C. (2006). *Reading: After Method*. Available at: http://locus.cwrl.utexas.edu/spinuzzi/?q=node/92 [17.04.06]

Spivak, G.C. (1994). Responsibility. *boundary* 2 (21), pp.19-64

Stengers, I. (2000). *The Invention of Modern Science*. Minneapolis: University of Minnesota Press

Swift, R. (2006). *Trigger Issues: Mosquito*. Oxford: New Internationalist Publications

Szerszynski, B. (2005). Beating the Unbound: Political Theatre in the Laboratory without Walls. In Giannachi, G., and Stewart, N. *Performing Nature: Explorations in Ecology and the Arts*. Frankfurt and New York: Peter Lang. pp. 181-97

Taipei Times (09/10/2006). *British American Tobacco creates row over malaria*. Available via: http://www.taipeitimes.com/News/world/archives/2006/10/09/2003331007 *(accessed:* 10/10/2006)

Tarimo, D.S., G.K. Lwihula, J.N. Minjas and I.C. Bygbjerg. (2000). Mother's Perceptions and Knowledge on Childhood Malaria in the Holendemic Kibaha District, Tanzania: Implications for Malaria Control and the IMCI Strategy. *Tropical Medicine and International Health*. Vol.5, pp.179-184

Teklehaimanot, A., McCord, G.C., Sachs, J.D. (2007). Scaling Up Malaria Control in Africa: An Economic and Epidemiological Assessment. *Am. J. Trop. Med. Hyg*., Vol.77(Suppl 6), 2007, pp. 138–144

Teklehaimanot, A., Sachs, J. and Curtis, C. (2007). Malaria control needs mass distribution of insecticidal bednets. *The Lancet*. Vol 369: 2143-46

The Global Fund (2006). *A Force for Change: The Global Fund to Fight AIDS, Tuberculosis and Malaria*. Geneva: The Global Fund

The Global Fund (2008). The Global Fund to Fight AIDS, Tuberculosis, Malaria: Pledges. Available via: http://www.theglobalfund.org/en/resources/?lang=en (30/11/08)

Thompson, C. (2001). When Elephants Stand for Competing Models of Nature. In A. Mol and J. Law eds., *Complexity in Science, Technology, and Medicine*. Duke: University Press

Tia E., Akogbeto M., Koffi A., Toure M., Adja A.M., Moussa K., Yao T., Carnevale P., Chandre F., (2006). Pyrethroid and DDT resistance of Anopheles gambiae s.s. (Diptera: Culicidae) in five agricultural ecosystems from Cote-d'Ivoire. Bull Soc Pathol Exot, Vol. 99(4):278-282

Tsing, A. (2005) *Friction: An Ethnography of Global Connection*. Princeton: University Press

Turnbull, D. (1989). The Push for a Malaria Vaccine. *Social Studies of Science*, Vol.19(2):283-300

U.S. Department of Health and Human Services (2002). *Toxicological Profile for DDT, DDE and DDD*. Available via: http://www.atsdr.cdc.gov/toxprofiles/tp35.html

UNICEF (2007). Monitoring the Situation of Children and Women, MICS Ghana, 2006, Preliminary Report. Accessible via: http://www.childinfo.org/mics3_surveys.html (11/08/08)

UNICEF CA (2008). *Our work: Malaria*. Accessible via: http://www.unicef.ca/portal/SmartDefault.aspx?at=1901 (last accessed 16/09/09)

United Nations (UN) (2001). Stockholm Convention on Persistent Organic Pollutants. Available via: http://chm.pops.int/Convention/tabid/54/language/en-US/Default.aspx#convtext (20/07/07)

US Environmental Protection Agency (US EPA) (31/12/1972). *DDT Ban Takes Effect*. Available via: http://www.epa.gov/history/topics/ddt/01.htm (17/08/07)

Van Loon, J. (2000) 'Parasite Politics: On the Significance of Symbiosis and Assemblage in Theorizing Community Formations'. In Pierson, Chr., and Tormey, S. (eds) *Politics at the Edge*. London: MacMillan. pp.241-253

Vaughan, M. (1991). *Curing their Ills. Colonial Power and African Illness*. Cambridge: Polity

Verran. H. (2001). *Science* and an *African Logic*. Chicago: University of Chicago Press

Watts, Sheldon J. (1997). *Epidemics and history: disease, power and imperialism*. Yale: University Press

Wahab, H. (2008). *Universal Healthcare Coverage: Assessing the Implementation of Ghana's NHIS Law*. Accessible via: http://www.indiana.edu/~workshop/seminars/papers/wahab_mcpaper08.pdf (10/05/2010)

Wellcome Witnesses to Twentieth Century Medicine (1999). *British contributions to medical research and education in Africa after the Second World War*. Available via: http://www.ucl.ac.uk/histmed/publications/wellcome_witnesses_c20th_med (08/09)

Whatmore S. (2002) *Hybrid Geographies: Natures, Cultures, Spaces*. London: Routledge

WHO (1991). *Basic Malaria Microscopy. Part I Learner's guide*. Geneva: WHO

Williams, H.A. and Jones, C. O. H. (2004). A critical review of behavioral issues related to malaria control in sub-Saharan Africa: what contributions have social scientists made? *Social Science and Medicine*, Vol. 59(3), pp. 501-523

Witzel, A. (2000). The problem-centered interview [27 paragraphs]. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research [On-line Journal], 1*(1). Available at: http://qualitative-research.net/fqs [10.03.06]

World Health Organization WHO (1978). *Declaration of Alma-Ata*. Available via: www.who.int/hpr/NPH/docs/declaration_almaata.pdf (03/05/09)

World Health Organisation WHO (2000). Manual for Indoor Residual Spraying. Application of residual sprays for vector control. Geneva: WHO/CDS/WHOPES/GCDPP/2000.3 Rev.1

World Health Organization WHO (2005). *World Malaria Report 2005*. Geneva: WHO/HTM/MAL/2005.1102

World Health Organization WHO (2006). *Indoor residual spraying. Use of indoor residual spraying for scaling up global malaria control and elimination*. Geneva: WHO/HTM/MAL/2006.1112

World Health Organization WHO (2007). Insecticide-treated mosquito nets: a position statement. Accessible via: http://www.who.int/malaria/publications/atoz/itnspospaperfinal/en/index.html (22/10/2008)

World Health Organization WHO (2008a). *Global malaria control and elimination: report of a meeting on containment of artemisinin tolerance, 19 January 2008, Geneva, Switzerland.* Geneva: WHO: WC 770

World Health Organization WHO (2008b) *World Malaria Report 2008*. Geneva: WHO/HTM/GMP/2008.1

World Health Organization WHO (2008c) *World Malaria Report 2008: Backgrounder on Methods*. Available via: http://apps.who.int/malaria/wmr2008/ (20/11/08)

Worrall,E., Basu, S., Hanson, K. (2005). Is malaria a disease of poverty? A review of the literature. *Tropical Medicine and International Health*. Volume 10 Issue 10, pp:1047-1059

Wynne, B. (1996). *May the sheep safely graze? A reflexive view of the Expert-Lay Knowledge divide*. in: Lash, S., Szerszynski, B., Wynne, B.. Risk, Environment, and Modernity: Towards a new Ecology. London: Sage, pp.44-83

Yeboah-Antwi K. et al. (2001). Impact of prepack- aging antimalarial drugs on cost to patients and compliance with treatment. *Bulletin of the World Health Organization*, 79(5):394–399

Yu, H. and Zhong, S. (2002). Artemisia Species in the Traditional Chinese Medicine and the Discovery of Artemisinin. In: Wright, C.W. *Artemisia*. London: Taylor and Francis. Pp: 149-157